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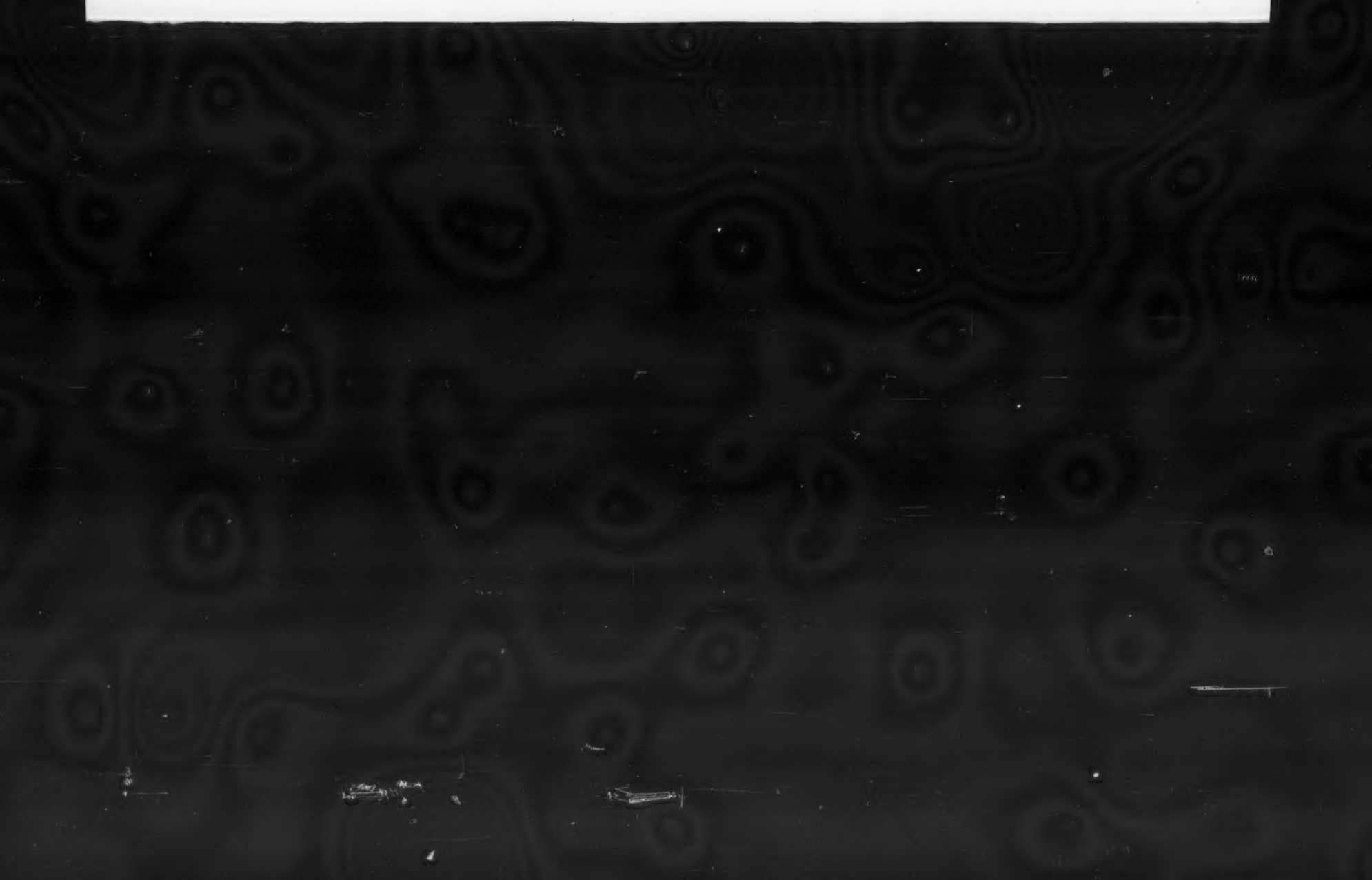

THE HEALTH OF FORESTRY WORKERS:

A SURVEY OF THE WOMEN'S TIMBER CORPS OF GREAT BRITAIN

BY

CATHERINE N. SWANSTON *

London

Introduction

In normal times Great Britain imports all but 4 per cent. of the timber needed for her industrial requirements, chiefly from Canada, Scandinavia and the Baltic States, and forestry work in this country is carried on by the Forestry Commission and private owners, who do research and re-afforestation, and clean up woodland areas. War with Germany, however, resulted in a rapid and considerable drop in imports; the Baltic was closed, the Scandinavian countries were overrun and shipping could not be spared to bring large quantities of timber from Canada. At the same time there was a heavy demand at home. Timber was needed for army camps, for hostels, air stations, field telegraph poles, for beach landing runways, ammunition boxes and field hospitals, and at the same time essential civilian demands such as pit props and railway sleepers had to be met. In 1940, therefore, the Forestry Commission recruited a number of girls from the Women's Land Army to work in the woods and sawmills up and down the country, and in April 1942 the Women's Timber Corps was founded and became a working unit of the Home Timber Production Department of the Ministry of Supply. All the forestry girls working for the Forestry Commission were absorbed into the Corps and, in addition, many more were recruited from the Land Army.

The Work of the Women's Timber Corps

The Corps extends over England, Scotland and Wales, and at its zenith numbered nearly 6000 members. It may be apposite here to give some description of the work done by the girls. The major operations are felling, measuring, hauling out, stacking, loading and converting. This is the timber production work proper. In addition, there is saw bench work—mainly cutting small trees into pit props; and 'snedding'—hacking off the small branches from felled trees with a billhook or light axe. Trees destined for use as telegraph poles have also to be stripped of their bark, an operation known as 'peeling.' Finally, on some sites, the brushwood has to be cleared away and burnt. Horses and tractors are used for hauling timber away from the woods and the girls become adept at managing the one and driving the other; they also drive the heavily loaded lorries between the sites and the rail-heads and load the rail trucks themselves. Many girls work in sawmills, both in Government establishments and in private firms, and much of this work is arduous, as heavy timber is handled and considerable strength is required to lever the logs into position on the saw-bench. Here the girls often work with men and provided they are not put on to jobs which are too heavy for them, can maintain a good level of output. They learn to manipulate the different types of saws and some have apprenticed themselves to 'saw doctors' and learnt something of the art of setting saws.

In order that the nature of the work shall be properly appreciated it is necessary to describe in detail the chief timber production processes. The majority of girls are general forestry workers, that is, they do not work in sawmills, neither are they specialists, such as fellers or measurers. They are chiefly employed on cross-cutting or burning and clearing. Felling is probably the hardest operation of all. Fellers work in pairs and while there was great enthusiasm for this job at first, and there are still a number of excellent pairs of fellers in many parts of the country, the tendency has been for the girls to drop off felling or for the foreman to take them off because of their low output, and for them to concentrate more on cross-cutting and stacking, or clearing and burning, specially in those areas where the stands of timber are not easy. The job itself consists of two processes: 'laying-in' or 'rounding up' which is axeing a wedge out of the base of the trunk so that the tree shall fall properly, and cross-cutting with a two-handled saw through the trunk at the apex of the wedge. A woodman's axe weighs 7 lb. and when hard timber is being felled, the process of laying-in is the hardest part of all as the axe must be swung with considerable vigour. After the tree has been felled and snedded, and the trunk peeled, if this is required, it is then hauled out of the wood and either loaded on to a pole wagon as a complete tree or sawn off into lengths at the saw-bench and stacked or loaded into lorries. The saw-bench is trying work as the trunk

* Recently Assistant Chief Medical Officer to the Ministry of Supply.

FIG. 1.—Felling. The axe strokes mark the way the tree will fall.

FIG. 2. — Saw-bench. Cutting the logs.

FIG. 3.—Sawing timber to lengths for pit props.

has to be lifted on to the bench and held in position during sawing. The circular saws used for this operation are often somewhat haphazardly guarded, yet serious accidents are unknown. Stacking of pit props and sleepers, some of which weigh 60 lb. and all of which are awkward loads, is hard and tiring work and this also applies to the loading of lorries and railway trucks. The girls work in small groups under the supervision of a 'ganger,' who in her turn is responsible to the foreman or forewoman of the site. On some sites men do the heavy hauling and felling, and much of the work done by the girls is felling conifers (soft wood) for use as telegraph poles and pit props. This gives an indication of the size of the trees handled in the woods.

A certain number of girls are employed as measurers, whose job is to measure the felled timber and to calculate the amount of available wood in each tree. They also survey new woods and mark off trees suitable for felling. This job is slightly better paid than general forestry work, special training is needed and intelligent girls with some mathematical ability are usually chosen. This work is not heavy except in so far as the measurer may be asked to give a hand in hauling timber, but it is often lonely as many of them work singly or in pairs on sites which have been completely felled and from which all the other workers have left.

Working and Living Conditions

The working environment of the Timber Corps is made up of the fields and woods of the countryside, and while certain things can be done to increase the comfort of the civilized individual working in natural surroundings, the all-important factor on this job is the weather. Conditions vary from ideal in summer (except when it is very hot) to almost unbearable in winter, and during the cold spells of last winter (1944–45) many of the timber camps (especially in Scotland) were completely snowed up. Lorries could not be got on to the roads to take the girls to work and at one camp food had to be fetched several miles by an improvised horse-sleigh. Working sites are provided with wooden huts, usually of the movable type, which can be heated by a stove and in which the girls can shelter during the rain. The girls themselves wear uniform similar to that of the Land Army and work in breeches, dungarees or, in the hot weather, shorts.

They live in hutted camps built specially for the Corps and accommodating 20–50 girls in each; in private houses which have been requisitioned for use as small hostels; in the large hostels attached to the Royal Ordnance Factories, where they form a small unit among the other industrial workers; and in selected private billets. In Scotland, camps and small hostels predominate owing to the isolated working sites and the difficulty in finding billets, but in England and Wales, where billets are much more plentiful, the majority of girls live in these. On the whole camps are more popular than billets and they possess certain obvious advantages, such as the provision of adequate means for drying wet clothes and proper sick-bay arrangements for looking after girls who are ill. Many of the girls themselves are trained in first aid and minor injuries at work are treated on the site with the aid of a first-aid box.

Medical Survey of a Group of Workers in the Corps

During the summer of 1945 a survey was undertaken to try to find out what harmful effects, if any, were likely to be produced in women by forestry work. A certain uneasiness had been evinced by Production and Welfare Officers * in different parts of the country on account of the rising sickness rate among members of the Corps. In some places production was being seriously affected and there was a growing impression that many of the girls were beginning to feel the strain of several years in the woods and sawmills. It appeared that this high sickness rate was largely influenced by three factors:

(1) The prevalence of locomotor diseases, particularly muscular rheumatism.
(2) Gastro-intestinal complaints.
(3) An increasing amount of menstrual sickness.

Special attention was therefore paid to these points during the interviews and examinations which made up the survey.

One hundred and sixty-one girls were seen in all parts of the country and as the investigation took place in the weeks immediately following a widespread heat-wave the girls were seen under ideal conditions, and most of them looked extremely fit and sunburned. Owing to the difficulty of carrying out examinations in private houses the majority of those interviewed were camp or hostel residents, and only 30 billeted girls were seen, all in England and Wales.

It was considered desirable that all examinations should be voluntary as it was necessary to gain the confidence and co-operation of the girls. There was no lack of volunteers, in fact it was sometimes impossible to examine all who offered. Every forestry and sawmill job was represented, the largest groups being fellers (50), saw mill and saw-bench workers (27) and measurers (16). The length of service in the Corps—including previous service in the Forestry Commission, but not in the Women's Land Army—varied from under two to over four years, with the greatest number (87) in the 2–3 year group. In assessing the information obtained, therefore, it must be borne in mind that because the group was made up of volunteers, it may not be a representative sample.

The age groups were as follows: 19 years, 19; 20–24 years, 100; 25–29 years, 29; 30–34 years, 12; 35–39 years, 1; i.e. a total of 161.

The lower age limit for joining the Corps is 17 and many girls do in fact enter at this early age.

* The Women's Timber Corps is divided, geographically, into nine areas or Divisions for administrative purposes, each with its own Production and Welfare Officers.

FIG. 4 (left).—Stripping the bark from a tree to be used as a telegraph pole.

FIG. 5 (below).—(Snedding.) Removing branches from a felled tree.

They are recruited through the Land Army, but all recruitment ceased in September 1943 which, perhaps, accounts for the large number of 20–24-year-olds.

Medical Examination

1. *Interview.* A careful history was taken which included a detailed working history since entry into the Corps, with a note of the girl's previous occupation. Most of the girls were town bred, many from the great industrial cities of the North and Midlands and in Scotland from Glasgow and Edinburgh, and while the majority came from factories a wide variety of occupations was represented, including shop assistants, hairdressers, children's nurses, clerks and switchboard operators. With a few exceptions they enjoyed the Timber Corps and felt the open-air life had done them good. Many said that they did not want to return to their old jobs in factories or offices, but would prefer to continue on the land.

Only a proportion of girls had received a medical examination on entry, and in many cases this was little more than a formality. No records had been kept of these examinations, and there were therefore no basic data concerning the physical condition of these girls when they started forestry work for comparison with their state of health at the time of this survey.

Details of past illnesses were noted and those occurring since entry into the Corps were later checked against sickness records, and special attention was paid to eliciting information of gastro-intestinal disturbances, menstrual dysfunction and the occurrence of rheumatism, fibrositis and myalgia. Every girl was asked whether she had lost or gained weight since she entered the Corps, whether she was feeling fit or beginning to get tired, and whether she had contemplated leaving on account of health reasons. All girls presenting themselves for examination had been asked to be weighed and measured during the previous week and this had been done in most cases.

2. *Physical Examination.* The physical examination following the interview comprised an appraisal of the general physique, inspection of mouth and throat, examination of the heart, lungs and abdomen and measurement of blood pressure. In a few cases urinalyses and exercise tolerance tests were done. A rough estimation of the haemoglobin level by the Tallquist method was also done on every girl. It is realized that this is not an accurate evaluation, but it was the only possible method for this survey as many of the examinations had to be carried out under somewhat primitive conditions.

General Physical Standard

In general the physique of the girls was good and in a number it was really excellent. In many of those engaged on felling or other heavy jobs there was a marked development of the muscles of the shoulder girdle, upper chest wall and arms, the pectoral and deltoid muscles in particular being hypertrophied. The girls looked well, with clear eyes and skin, and many of them were deeply tanned through working during the hot weather in a minimum of clothing. They were alert, high spirited and ' full of beans.' The physical examination itself revealed nothing abnormal in the great majority. Twenty-six girls showed a mild degree of anaemia (Hb 70 per cent. or under—Tallquist) and there were a good many complaints of constipation due possibly to too much starchy food (the daily lunch is eaten in the woods and consists of sandwiches washed down by quantities of tea) and lack of lavatory facilities on the working sites. Only occasionally was dental caries found; most girls took good care of their teeth and paid fairly regular visits to their dentists.

TABLE 1
AGE/WEIGHT GROUPS

Age groups	Normal weight	Over-weight	Under-weight	Total
–19 years	3	12	4	19
20–24 years	20	56	20	96
25–29 years	5	14	8	27
30–34 years	3	4	5	12
35–39 years	—	—	1	1
Total ..	31	86	38	155

Using standard height/weight/age tables * for comparison it was found that 38 girls out of 155 weighed were underweight, 86 were overweight and 31 were within normal limits. The group of overweights need not be considered further; very few cases of obesity were found and the increase was generally of the order of a few pounds and could be accounted for by increased physical development. The underweights showed variations from a few pounds to over 2 stone and included in this group was a number of girls suffering from definite pathological conditions such as chronic bronchitis, spinal scoliosis and general debility. In the older age groups, that is from 25 onwards, there was a higher proportion of girls underweight than in the 19–24 group—33 per cent. as against 20 per cent.—and a higher proportion of those who had ' had enough ' and wanted their release from the Corps. Similarly the underweights as a group showed a much higher proportion of those who wanted to leave than the others. The chief reason given was increasing fatigue.

TABLE 2
COMPLAINTS OF FATIGUE IN RELATION TO WEIGHT

	Total	Fatigue	Per cent.
Normal or over-weight	117	15	13
Underweight ..	38	13	34
Total	155	28	18

* From the American Life Extension Institute.

FIG. 6 (right).—Pit props, sawn to length, are stacked for transport. Three girls carrying a prop to the stack. (Weight of log is about 156 lb.)

Fig. 7 (left).—Stacking pit props.

TABLE 3

COMPLAINTS OF FATIGUE IN RELATION TO AGE GROUPS

Age groups	Total	Fatigue	Per cent.
19 years ..	19	1	10
20–24 years ..	100	12	12
25–29 years ..	29	7	25
30–34 years ..	12	7	55
35–39 years ..	1	—	—
Total	161	27	17

It was found that complaints of fatigue increased with length of service up to a maximum for those who had been in the Corps over three but under four years. After 4 years of service a slight decline was observed.

TABLE 4

COMPLAINTS OF FATIGUE IN RELATION TO LENGTH OF SERVICE

Length of service	Total	Fatigue	Per cent.
–2 years ..	25	1	4
2–3 years ..	88	14	17
3–4 years ..	30	9	30
Over 4 years ..	18	4	22
Total	161	28	17

In computing these figures no attention was paid to compassionate reasons for release, physical grounds only being taken into consideration. Of the 38 underweights 21 had lost weight during their service in the Corps, and while many of them were thin and weedy with poor muscular development, this group included two of the healthiest girls seen.

Certified Sickness

Records were obtained for the 161 girls seen in the areas visited for the year ending June 30, 1945. One hundred and twenty-one girls had been off work due to certified sickness and had lost between them 3242 days, an average of 20 days lost over the whole group. This does not include lost time owing to works accidents.

The chief causes of sickness were gastro-intestinal complaints (12·3 per cent.), locomotor diseases (17·4 per cent.) and surgical conditions (26·7 per cent.). The last group included 5 cases of appendicitis who lost between them 425 days, which represents half the total for this group. Influenza, colds and respiratory conditions accounted for 13·4 per cent. and nervous conditions 7·7 per cent. The full analysis is given in Table 5.

Medical Discharges

The medical discharges in the Divisions visited numbered 323 over the same period (Table 6). This is 40 per cent. of all releases from those areas. It will be seen from the following analysis that the chief reasons given were respiratory, locomotor complaints (rheumatism) and debility. The after effects of accidents at work also accounted for a sizeable fraction and pregnancy for nearly 20 per cent. While this is too small a group to be of statistical value, these figures are interesting, in that they show a high sickness rate and a high discharge rate in a selected group of young women doing rather specialized work. In their interpretation certain points should be borne in mind.

In the first place forestry work is all hard work, with the exception of measurers whose work generally is lighter, and cannot be done by the girl who is convalescent after an illness or who needs a 'light' job. There is no alternative work on the timber site or in the sawmill, and the girl who has

TABLE 5

SICKNESS ANALYSIS

Group	Disease	Total days lost	Per cent. of total absence	Days lost per person
1	Influenza, colds	185	5·8	1·1
2	Respiratory	246	7·6	1·5
3	Cardio-vascular	104	3·3	0·6
4	Gastro-intestinal	396	12·3	2·5
5	Nervous ..	250	7·7	1·6
6 *a*	Skin, general	36	1·0	0·2
b	Skin infestation	164	5·0	1·0
7	Locomotor ..	564	17·4	3·5
8	Surgical ..	865*	26·7	5·3
9	Infectious fevers	13	0·4	0·1
10	Gynaecological	82	2·5	0·5
11	Anaemia ..	33	1·0	0·2
12	Varicose veins ..	24	0·7	0·2
13	Various ..	280	8·6	1·7
Total		3242	100·0	20·0

* Includes 5 cases of appendicitis who lost together 425 days.

TABLE 6

DISCHARGES FOR MEDICAL REASONS

Diagnosis	Number	Percentage of total
Respiratory	37	11·0
Cardio-vascular	4	1·2
Gastro-intestinal	16	4·4
Nervous debility	68	21·0
Skin conditions	8	2·4
Locomotor	56 [5]*	17·0
Gynaecological	4	1·2
Accidents at work ..	26 [17]*	8·3
Anaemia	7	2·3
Varicose veins	4	1·2
Pregnancy	62	19·9
Surgical	12	3·4
Various	19	6·7
Total	323	100·0

* Raised figures indicate cases of strains and sprains.

FIG. 8 (above).—Loading pit props into lorries for transport to rail-head. (Weight of log being lifted is about 37 lb.)

FIG. 9 (below).—Work in a sawmill.

been off sick needs to be pretty fit before she can come back to work at all. This doubtless prolongs each spell of sickness. Secondly, a medical release is often the easiest way of leaving the Corps in the absence of strong compassionate grounds. On the other hand, forestry workers are chiefly in the younger age groups and are not, except in very few cases, saddled with domestic duties or have long journeys to and from work. They are living a healthy life, and the great majority are being well fed and looked after in camps or carefully chosen billets.

Gynaecological Conditions

Menstrual irregularities are known to result from a change in living conditions or from taking up different work, specially if the latter is physically exacting. In this survey 37 girls said that their menstrual periods had got worse since they took up forestry work, the chief complaints being increased pain (20), increased bleeding (17) and irregular or more frequent periods (10). Ten of this group said they only had trouble if they were on particularly heavy work—felling was the chief process mentioned. On the other hand, 15 girls said that they had less pain, and 3 that they had been more regular since they entered the Corps. It is not possible to assess the exact amount of time lost through menstrual dysfunction as many odd days off are not recorded, but it is unlikely that this is a great deal as only 33 girls stated they took time off and of these the majority only occasionally. It is generally recognized that heavy work may produce dysmenorrhoea and menorrhagia, and therefore a certain amount of time lost among these girls is to be expected. Sickness records for the group show only a proportion of 2·5 per cent. for certified sickness due to gynaecological causes, and this is no higher than that found in other industrial groups. Again, out of 323 discharges only 4 were due to gynaecological conditions and throughout this survey not one case was encountered sufficiently serious to warrant a recommendation for release.

Locomotor Diseases, including Rheumatism

17·4 per cent. of all time lost through certified sickness was due to locomotor conditions, chiefly rheumatism. This is more than double the proportion lost by women in the Royal Ordnance Factories. Very few of these girls gave any history of a rheumatic diathesis, but a good many said that they often had muscular limb pains during wet weather. Rheumatism, fibrositis, myalgia and neuritis may almost be said to assume an occupational significance in relation to forestry work. The high incidence is, no doubt, occasioned by the unavoidable working conditions in wet and cold weather, by travelling home in wet clothes and the difficulties of thorough drying in billets.

Apart from rheumatism itself, a good deal of time was lost and a good many girls discharged through traumatic strains and sprains. The time lost has been omitted from the certified sickness analysis, but in the records received, they account for 462 days lost at least in the group of 161 girls over one year. Of 26 girls who were discharged on account of disabilities arising from accidents at work 17 were suffering from strained muscles.

Gastro-intestinal Complaints

Dyspepsia and gastritis accounted for most of the time lost in this group. The relatively high proportion (12·3 per cent.) might be influenced by the daily sandwich lunch, the bulk of which is often eaten during the mid-morning break and there is a subsequent long period without food until the evening meal. It appeared, too, that a good many girls ate an excess of starchy foods, which might give rise to a carbohydrate dyspepsia. Very few girls complained of severe digestive disturbances, and none showed any signs of serious trouble.

Discussion

The information gained in this survey provides conflicting evidence in respect of the health of these girls. At the interviews, they were on the whole a healthy, cheerful and contented group, many of them looking extremely fit. The subsequent physical examinations produced little to counteract this impression, and without going further, it would not have been unreasonable to give them a clean bill of health and assume that there was no cause for uneasiness. But investigation of the sickness absence of the group told a very different tale. Seventy-five per cent. were absent during the period under review, a high proportion, and between them lost 3242 working days, an average of 26 days each or 20 days for the whole group. Forestry work is strenuous and to the stresses of the job itself are added the trials of damp and cold. Much of the work requires a sustained physical effort and good muscles and strong limbs are needed. Though they speak well of the ability of the girls to tackle and master the different operations, Production Officers have told me that two good hard-working girls can do no more than equal one man's output, and I have heard the ratio put as low as four to one when the girls are becoming tired. This discrepancy in output is not surprising when it is remembered that a woman's physical strength is only about half that of a man. Many girls underwent a period of training on first joining the Corps, but in any future training courses stress should be laid on the correct methods of lifting and carrying weights. Failure to do this will inevitably result in a high incidence of strains and sprains.

Forestry girls are probably less subject to the stresses and strains of war-time existence than any other industrial group. They are away from home it is true, but they are mainly in safe country districts (an exception must be made for those girls in south-east England during the flying-bomb era) and they have no household duties when they get back from work. Yet each area shows a lengthy list of discharges on medical grounds of girls who have failed to stay the course. The Corps at

present represents the survival of the fittest, and in the small group which made up this survey there were a number who complained of increasing fatigue and who viewed with some alarm the prospect of spending another winter in the woods. An occupation which gives rise to so much general sickness cannot be considered altogether suitable or satisfactory work for women. When their relatively low level of output is also taken into consideration it becomes doubtful, apart from any risk to health, whether the employment of women in forestry work can be economically justified. Nevertheless they might be needed in some future crisis, and the following suggestions are put forward for consideration should any re-establishment of the Corps become necessary :

1. The age limits of entry should be 20–30 years. Exceptions might be made in the case of women over 30 who are used to strenuous open-air work.

2. Girls should be medically examined before acceptance by doctors who are familiar with the hazards of the job. During this war several instances have arisen of girls being recommended for timber work because it was considered that they required an open-air life.

3. A half-yearly medical check-up should be compulsory during service in the Corps.

4. Particular attention should be paid to the provision of proper clothing, including waterproof and windproof garments for winter wear of a suitable type.

5. Camps should be provided in preference to billets and proper means for drying clothes should be realized.

6. Good covered transport should be provided to and from working sites and each site should be provided with a hut or shelter which is waterproof and can be heated.

7. Mobile canteens capable of delivering hot meals and hot drinks to the working sites would do much to maintain a proper standard of nutrition and reduce the incidence of digestive complaints. A full hour should be allowed for the mid-day meal.

8. All recruits should receive an initial period of training which should include the teaching of proper methods of handling heavy timber.

Summary

During the summer of 1945 a survey was undertaken of a group of girls employed in the Women's Timber Corps to try and determine what effects, if any, forestry work produces in women.

A hundred and sixty-one girls were interviewed and physically examined. Of these 30 lived in private billets, and 131 in camps and hostels. Every type of forestry work done by women was represented, including sawmills, and many different parts of the country were visited.

The general health at the time of examination was found to be good in most cases. Thirty-eight were underweight and 28 wished to leave the Corps for health reasons, chiefly fatigue. The loss of weight and tiredness were commoner among those over 25 years of age.

The sickness rate for the group averaged 20 days lost by each worker. Of this, one-sixth was due to locomotor diseases, chiefly rheumatism.

Discharges on medical grounds accounted for 40 per cent. of all releases in the areas visited over a period of one year. Of these one-sixth were on account of rheumatism and locomotor diseases, and 26 girls were released because of the after effects of accidents at work.

Gynaecological complaints accounted for no more lost time than would be found in any other group of industrial workers. Thirty-seven girls (23 per cent.) gave a history of menstrual irregularities of some sort and 33 girls (20 per cent.) took occasional days off, and these occasional conditions accounted for only 4 out of 323 medical discharges.

There is apparently a high incidence of muscular strains and sprains in the group and these formed the majority of lost-time accidents.

It is considered that the employment of women in forestry work is not normally justifiable on account of their high sickness rate and comparatively low level of output, but in the event of it becoming necessary ever to re-form the Women's Timber Corps, certain suggestions have been put forward for safeguarding the health of its members.

Acknowledgments

For help in this work I am indebted to the Home Timber Production Department of the Ministry of Supply, in particular to Miss M. E. Hoskyn the Chief Officer, and the Divisional Welfare Officers of the Women's Timber Corps who co-operated in the survey. I also have to thank Dr. A. J. Amor, Chief Medical Officer of the Ministry, for permission to publish this report.

I have also to acknowledge with thanks permission to reproduce the photographs as follows: figs. 1 and 9, from *Illustrated Leicester Journal*; figs. 2 and 5, from *Sport and General*; figs. 3, 4, 6, and 7, from Ministry of Information; and fig. 8, from Planet News, Ltd.

MEDICAL GRADING OF THE INDUSTRIAL WORKER

BY

J. P. ELIAS*

Llandudno

Towards the middle of 1943 the problem of supplying workers to replace the labour turn-over in a large Royal Ordnance Filling Factory became more acute through the transfer of a large number of the younger male and female workers to the forces and to other industries. Local recruitment on a large scale was necessary and in the fourth year of total war unemployed persons in an industrial area were inevitably for the most part physically substandard or aged. The level of production of filled ammunition had to be maintained and this could only be done if full use was made of the maximum productive capacity of each individual. At a meeting of senior production and labour management staffs, instructors of the Training School and the medical officers, it was agreed that the work carried out in the factory fell within five grades, and the medical department was asked to determine at the time of the entrant's examination which grade of work could be most efficiently performed by the applicant. The agreed grades of work were as follows:

(1) Heavy general labouring.
(2) Rough assembly, i.e. unskilled work involving the handling of stores not exceeding 25 lb. in weight.
(3) Machine operating.
(4) Semi-skilled assembly.
(5) Skilled assembly.

It was decided to limit initially the entry of graded labour to 800 men into one section of the factory, a section in which there was a demand for all five grades of labour. The selective medical examination of entrants being wholly the responsibility of the medical department, it was necessary to organize in detail a routine of examination that, in view of the large influx of new labour that was expected, would not consume too much of the time of the medical officers who had numerous other functions to carry out in the factory. All jobs carried out in the section were carefully reviewed and particular note made of a few specific jobs falling within the definition of each grade. Examples of these jobs are:

Grade 1. Loading railway trucks in transit sheds.

Grade 2. Unpacking and cleaning empty 4·2-inch trench mortar bombs.

Grade 3. Operating presses.

Grade 4. Wiring cartridges between the fins on the tail-piece of trench mortar bombs.

Grade 5. Assembling ignition devices.

Psychological Tests

It was obvious that it would be necessary to take into consideration personal qualities as well as physical fitness in selection of workers for these different grades of work; the machine operator required a degree of performance intelligence, the semi-skilled assembler required dexterity, and the skilled assembler required both dexterity and performance intelligence. In order to assess these qualities quickly and with some accuracy during the medical examination of large numbers of men, two psychological tests were incorporated in the scheme of examination, namely the Peg-in Board for dexterity and Cube Imitation for performance intelligence. Before deciding to make use of these two particular tests they were tried out on some of the women who were to be replaced by the new-coming men. A few good, average and indifferent workers were selected by the shop manager for testing. The speed which each worker was assigned on her test score, when correlated with the category to which the supervisory staff had assigned her as a result of her work record, assured the managerial staff of the value of grading. At the same time it gave us standards for allocating new entrants to grades requiring performance intelligence or dexterity. It was found that the good worker inserted 76 pegs into the board in 2 minutes and scored 7 at cube imitation test before breaking down, the average worker scored 65 and 5 and the indifferent worker 55 and 3 respectively.

Methods and Grading

To expedite and standardize examination the form shown in fig. 1 was devised, and this form accompanied the applicant in a planned circuit of the surgery. The first portion of the form was completed by clerks and nurses in various rooms with the help of a male orderly to collect urine specimens. The second portion was completed by a medical officer in a consulting room and the applicant then moved to another room to be assessed by a second medical officer. This assess-

* Previously Senior Medical Officer, Royal Ordnance Factory, Ministry of Supply, Bridgend.

BRIDGEND FORM 329

Name
Address
Age
History
Sight R. L. J.
Urine
B.P. over 50

Heart
Lungs
Skin
Abdominal Wall
Varicose veins
Muscular control
Physique

Peg Insertion
Cube Imitation

Fit for Factory ?
Fit for Contact ?
Grade

FIG.—1

ment was based on the recorded findings, but if necessary, re-examination directed to any doubtful feature assured a sound assessment of fitness to work in the factory and fitness to work in contact.* Finally, the accepted applicant was graded into his best work category.

Sometimes the medical officer was able to grade from the findings of the physical examination alone; for instance, a man's poor standard of vision or some limitation of function of a hand might be such that it was obvious that he would be unable to carry out work requiring the quality of dexterity, and he would be placed in Grade 1 or Grade 2 according to his physical capacity. But in the majority of cases the assessing medical officer required knowledge of his intelligence and dexterity, and the man was passed to an adjacent room, where the two selected tests were carried out by clerks who quickly became proficient after a little instruction. The scores were entered on the third portion of the form and the applicant returned for grading by the medical officer from the integrated record of the man's physical capacity and essential abilities.

Grading examinations were carried out on three days a week at the rate of 100 men a day and it was found that 20 men could be dealt with in an hour provided the doctor carrying out the physical examination was periodically relieved.

The psychological tests were readily accepted and a negativistic attitude towards the test situation was very rare indeed. It was soon apparent that the trial standard scores in the dexterity test of the average woman worker could be reached by a good proportion of those tested, but the score of the good woman worker (76 pegs in 2 minutes) was rarely reached and the score of 70 was accepted as the criterion of dexterity for placement in Grades 4 or 5. On the other hand, the distribution of scores in performance intelligence tests corresponded more closely to that of the women taken as standards and a score of 7 or upwards in the cube imitation test was required for placement in Grades 3 or 5.

The grade of each man who entered the factory was transmitted through the Labour Department to the Training School. Here the new entrant was tried out on various jobs and trained to perform those to which he showed most aptitude. The Chief Instructor of the Training School reported that the correlation between performance and medical grading was good, but we agreed that correlation diminishes with advancing age when patterns of movement are less readily acquired. The tests of abilities were necessarily superficial, for time was the over-riding factor when large numbers of men were urgently required for war production. The applicants were submitted from numerous Labour Exchanges scattered over a radius of 25 miles from the factory, the main industry of the area being coal-mining and some heavy metal industry.

As a total of 10,312 men were medically graded we had a valuable assessment of the quality of labour which was available in the country in the fourth and fifth years of total war. The data have been analysed from the point of view of industrial capacity in Table 1 and from the point of view of personal incapacity in Table 2.

Periodically a number of applicants who were passed fit for non-contact work only were not graded because at the time of their examination non-contact work was not available in the factory. The category of temporarily unfit has been confined to those who did not present themselves for re-examination. A large number who were regarded as temporarily unfit at the first examination were re-examined later and were included in their appropriate category when the temporary disability had been rectified.

Defects

Analysis of individual defects found by medical examination of 10,389 workers is given in Table 2.

Vision was regarded as defective if acuity was less than Snellen 6/18 with the aid of glasses if they are worn, and for Grade 5 (skilled assembly) near vision up to J2 was required. Visual defects were frequent in all age groups. Monoculars were at first totally rejected on account of the risk attached

* Fitness for contact implies, in a Royal Ordnance Filling Factory, fitness to work in contact with TNT, tetryl, fulminate of mercury and lead azide.

TABLE 1

ASSESSMENT OF INDUSTRIAL CAPACITY IN A GROUP OF 10,312 WORKERS

Age group	No. examined	Fit for contact Grades: Percentage of total graded						Fit for non-contact Grades: Percentage of total graded						Temp. unfit	Unfit
		Total	1	2	3	4	5	Total	1	2	3	4	5		
18–29	1782	1052	12·07	15·02	14·92	25·66	31·36	373	34·58	28·42	5·89	15·55	15·55	50	307
30–39	2011	1250	13·76	20·88	16·72	21·12	27·52	397	6·3	32·74	26·95	26·95	7·1	44	320
40–49	2256	1249	7·45	28·82	18·11	19·77	28·85	539	2·66	58·21	8·1	17·31	13·73	69	399
50–59	2444	1253	3·11	47·96	16·44	16·68	15·8	471	9·24	66·99	4·95	10·23	8·58	128	592
60 and over	1819	651	nil	64·25	8·89	19·05	7·68	400	nil	78·64	4·75	11·86	4·75	52	716
Totals	10312	5455						2180						343	2334

TABLE 2

ASSESSMENT OF PERSONAL CAPACITY IN A GROUP OF 10,389 WORKERS EXAMINED

Key: A=fit contact; B=fit non-contact; C=unfit.

Disability	Age group: 18–29 Number examined: 1794			Age group: 30–39 Number examined: 2011			Age group: 40–49 Number examined: 2285			Age group: 50–59 Number examined: 2469			Age group: 60 and over Number examined: 1830		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Defective vision (including monocular)	24	17	67	6	8	42	54	20	77	106	31	146	96	41	175
Illiteracy	8	9	25	—	—	13	10	8	12	9	9	26	6	5	21
Renal—															
Albuminuria	2	12	15	1	—	16	3	7	15	10	6	26	6	6	24
Glycosuria	6	—	4	—	2	7	25	1	8	27	3	5	14	4	16
Nephritis	—	1	2	—	1	—	—	—	1	—	—	—	—	—	—
Other renal	3	1	2	—	—	—	—	—	1	1	1	—	—	—	5
Hyperpiesis (BP. 180+)	1	—	—	—	—	1	2	—	1	13	1	23	24	15	73
Heart Lesions	66	17	17	18	6	22	30	4	22	42	8	30	26	13	101
Tachycardia	107	14	15	88	22	15	76	6	3	42	5	47	15	8	22
Lung lesions—															
Silicosis or pneumoconiosis	—	24	2	—	106	18	—	80	36	—	56	40	—	11	22
Reticulation	10	13	3	5	3	—	11	10	1	6	3	11	1	1	4
T.B.	2	8	10	—	1	9	—	—	6	—	1	2	—	—	1
Bronchitis	16	29	10	8	27	18	27	34	26	29	44	54	5	23	49
Other lesions	14	28	25	4	9	16	19	23	23	14	18	10	6	10	21
Skin lesions	19	35	17	5	26	11	13	17	26	14	18	17	4	18	21
Gastric disorders—															
Ulceration	—	9	5	8	54	15	1	—	—	—	2	9	—	—	1
Other disorders	18	28	6	—	—	6	11	18	16	17	6	8	1	3	6
Neurosis	35	11	32	9	5	26	11	2	13	8	2	16	1	—	8
Nystagmus	6	—	8	6	5	13	18	7	19	21	2	26	3	1	12
Disease of C.N.S.	3	2	3	—	—	4	1	2	8	3	2	7	3	3	10
Epilepsy	—	—	1	—	—	1	—	—	—	—	—	1	—	—	1
Hernia—															
Inguinal and femural—															
With truss	4	—	—	15	2	—	33	3	—	56	2	7	35	11	12
Without truss	—	—	—	1	—	7	7	2	10	4	3	23	8	3	39
Ventral	—	—	—	—	—	3	2	1	3	2	—	1	5	2	4
Rheumatism and arthritis	25	2	2	9	—	6	30	4	9	20	5	5	9	3	6
Physical deformity (including bone injury)	90	16	32	38	13	31	69	8	52	71	12	52	27	10	42

to work in explosives, but later they were accepted for work in the less dangerous jobs.

The number of illiterates in the lower age groups was higher than expected though the majority of them scored average or better in the performance intelligence test.

Albuminuria was regarded as a bar to contact work unless there was good reason to believe the renal function was undamaged; symptomless glycosuria was not regarded as a bar to contact work.

The blood pressure of applicants aged 55 years and upwards was taken as a routine, under that age only at the request of the examining medical officer. Tachycardia was recorded when no physical signs of cardiac disease were found and its significance was assessed by the medical officer responsible for grading.

Silicosis or pneumoconiosis was recorded from the declaration of compensated injury or disease in the past which is signed by every applicant, while under the heading "reticulation" were placed the cases of "dust on lung" which had been turned down by the Silicosis or Pneumoconiosis Board. Cases of reticulation without physical signs of bronchitis were accepted for contact work and were able to perform this work without difficulty, but certified silicosis and pneumoconiosis were barred from contact work. The early stage and even moderately advanced silicotic was usually able to work comfortably in non-contact powder filling shops, but those who readily developed dyspnoea or were in the advanced stages were quite unfit for a filling factory.

Most skin lesions are a bar to contact work though acne vulgaris and pigmentation changes do not apparently increase susceptibility to dermatitis from contact powders.

Neurosis was mostly recorded from the history, and the degree of mental discomfort (important in a factory handling explosive) was assessed by a medical officer who had some experience of psychiatry.

Nystagmus was a cause of rejection until symptoms had disappeared.

Hernias were rejected until they were provided with a suitable truss.

Summary

The value of medical selection and medical grading has been checked by reference to subsequent labour turn-over and to production output. During a period of 15 months, from an intake of 6072 men, 141 were discharged on medical grounds, and no loss of production followed the replacement of experienced workers on a large scale by new but graded labour.

Acknowledgment

My thanks are due to Dr. A. J. Amor, Chief Medical Officer, Ministry of Supply, for his guidance in the presentation of this report, to Mr. L. J. Corbett, Superintendent, R.O.F., Bridgend, for permission to publish these findings, and to the medical, nursing and clerical staff for their help in the work.

MEASUREMENTS OF RADIOACTIVITY IN AN INDUSTRIAL DIAL PAINTING ROOM

BY

C. J. BRAUDO and J. D. CRAGGS

From the Research Department, Metropolitan-Vickers Electrical Company, Manchester

The radiations from radioactive substances can cause severe and lasting damage to living tissue and their effects may, in extreme cases, be lethal. These radiations are divided into three classes, viz. alpha-, beta- and gamma-rays, which are given out by radium and thorium and other radioactive elements during their disintegration. Industrial hazards arising from the use of radioactive materials occur mainly among those workers engaged in the luminous dial painting industry and the causes of injury are:

(1) ingestion of solid luminous compound by inhalation of dust or due to slovenly working habits;
(2) inhalation of radon (radium emanation); and
(3) irradiation of the whole body by gamma-rays from any accumulation of active material.

The effects of the radiations and their physical characteristics have been dealt with by Browning (1944) and G. D. Rochester (1944) and will not be described here as, in this article, it is intended to deal mainly with the practical detection of these radiations and certain aspects of the methods for protection from them.

Since this work was completed J. C. Jones and M. J. Day (1945) of Middlesex Hospital have given the results of many tests of the type to be described hereunder. It is gratifying to find that the results obtained by us agree, in order of magnitude, with those of Jones and Day. Although the work dealt with here is less exhaustive it is offered as a confirmation, by a different technique of measurement, of the results of Jones and Day.

Tolerance Limits and Recommendations

To guard against those hazards caused by the use of luminous compound and in order to establish a standard of protection, recommendations have been set down by both British (1943) and American (1941) committees, in which are stated the tolerance dosages which are regarded as compatible with the maintenance of health by a person exposed to the effects of radioactive material. There is some discrepancy between the American and British recommendations; the Americans favour tolerance dosages one-tenth of those recommended by the British committee in dealing with radon, and approximately one-third of the British standard in the case of gamma irradiation. These tolerances are summarized in Table I. In addition, it is stressed by Curtiss (1942) and Evans (1943) that, when all three hazards are present simultaneously, the tolerances should be kept below the limits stated.

TABLE 1

Hazard	Tolerance dosage	
	British	American
Radium fixed in body	—	0·1 microgramme
Radon in atmosphere.. ..	10^{-10} Curies/litre	10^{-11} Curies/litre
Radon in exhaled breath ..	10^{-11} Curies/litre	10^{-12} Curies/litre
Gamma radiation	10^{-5} Roentgen/sec.	0·1 Roentgen/8 hr. day

Description of the Apparatus

The measurements undertaken during this investigation fall under two main headings: gamma-ray intensity measurements, and measurements of radon in air and in the exhaled breath. Use was made of the ionization chamber method for measuring the intensity of ionization in air caused by the presence of radioactive material.

Ionization Chambers

Two forms of ionization chamber were used during the investigation, both of an approximate volume of 1 litre. The chamber used for the gamma radiation measurements is made of wire gauze and, as may be seen from Fig. 1, took the form of a cube of approximately 4-inch side. The evacuable ionization chamber is cylindrical in shape and is shown in Fig. 2. The chamber consists essentially of a brass cylinder of 4-inch inside diameter and two brass end plates. The top plate contains two tubes, one connected to the vacuum pump and the other to the sample to be admitted to the chamber. Through the bottom plate projects the central wire of the ionization chamber and it is insulated from the chamber by means of the composite insulator shown.

A difficulty which often arises in the construction of ionization chambers is the choice of material and design for the insulator through which the central electrode passes into the chamber. In the case of the wire gauze chamber an insulator of amberoid (synthetic amber)

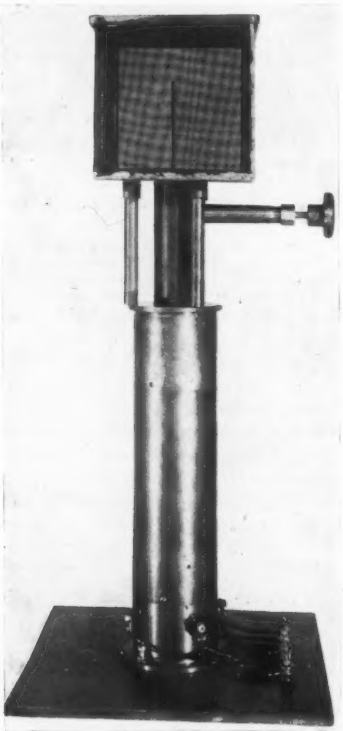

FIG. 1.—The wire-gauze ionization chamber mounted above the electrometer tube housing.

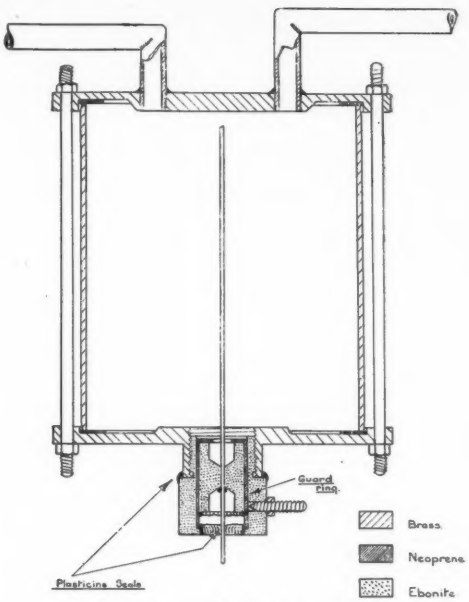

FIG. 2.—Evacuable ionization chamber.

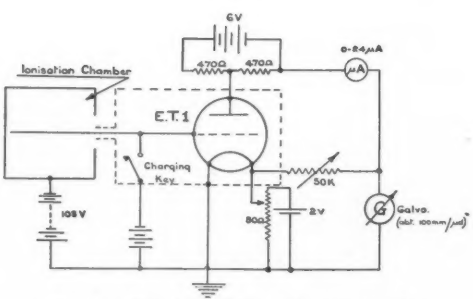

FIG. 3.—Circuit used for ionization chamber measurement.
(E.T.1=G.E.C. electrometer triode).

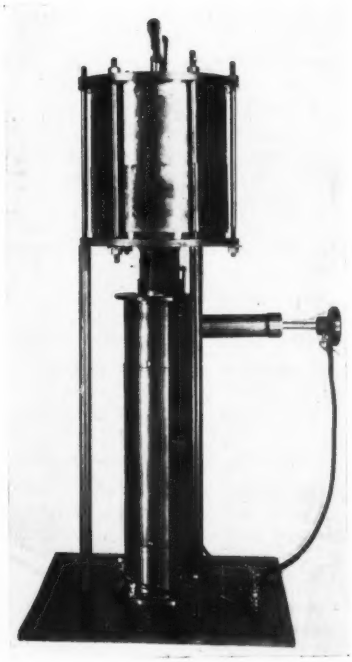

FIG. 4.—The evacuable ionization chamber and electrometer.

was found to give adequate insulation for the range of currents measured, but the leakage across the insulator increased with time due, presumably, to contamination of its surface by atmospheric conditions. The composite insulator used in the evacuable chamber was built of ebonite coated with ' Ceresin ' (a wax of non-hygroscopic character and high surface resistivity). It had been intended to build this insulator of Distrene or Trolitul synthetics which were, however, unavailable at the time. Nevertheless the wax-coated ebonite insulator showed itself entirely suitable for use in a system where the currents measured were of the order of 3×10^{-14} ampere.

Electrometer Circuit

An ET1 Electrometer Triode was used in conjunction with the chambers described above. The circuit is shown in fig. 3 and is seen to be a d.c. amplifier of the simplest possible design. The grid is charged by means of a charging key to a fixed potential, and any subsequent leakage of charge to or from the grid, which is connected directly to the central electrode of the ionization chamber, will be detected on the galvanometer G due to variation in the anode current. The rate of change of charge on the grid is a measure of the intensity of ionization and thus of the quantity of radioactive material present.

The electrometer triode itself is housed in the cylindrical brass casing to be seen in fig. 4. This case serves as an electrical shield and also to shield the valve electrodes from light. In addition, a desiccating agent (silica gel) is placed inside the shield to prevent the glass envelope of the valve from damp and consequent lowering of the surface resistance of the valve envelope.

Calibration of the Ionization Chambers

The linearity of response of the gauze ionization chamber with variation in the distance of a radioactive source was determined by means of gamma radiation from 0·2 mg. radium. Disregarding all sources of error the rate of change of anode current should vary inversely as the square of the distance (r) of the source. The experimental relation was (see fig. 5)

$$\text{Deflection} \propto \frac{1}{r^{2\cdot35}}.$$

This relation was regarded as sufficiently accurate to justify the assumption of the proportionality of the response of the chamber for a constant source at varying distance.

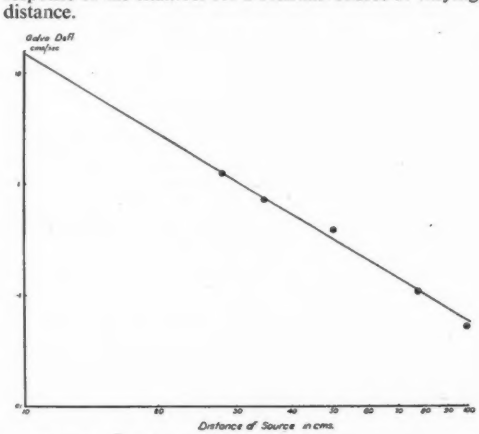

FIG. 5.—Calibration curve for 1-litre wire gauze ionization chamber with E.T.1 electrometer triode.

(Rate of Galvanometer Deflection (cm./sec.) vs. Distance of Radium Source. Galvo. Sensitivity—10 cm. per microampere. Radium Source—0·2 mg. Ra.)

Another series of tests was carried out to determine the response to a varying source at a constant distance. A satisfactorily linear response was obtained (fig. 6) but only after precautions had been taken to prevent ionization, caused in the air around the electrometer triode itself, from counteracting the results of good insulation. The method used was to shield the electrometer from the source by means of lead blocks. Another method used by many workers is to evacuate the electrometer shield and thus reduce ionization in the residual gas to negligible proportions.

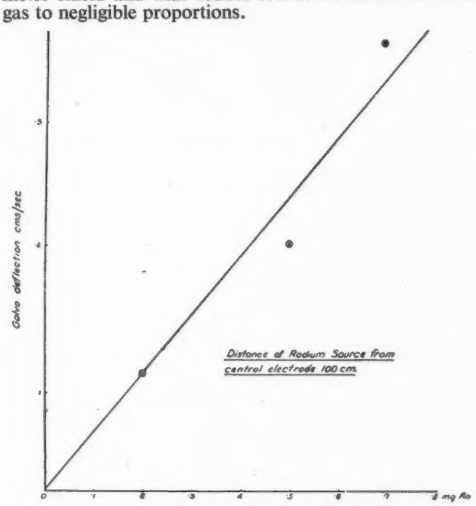

FIG. 6.—Calibration curve for 1-litre wire gauze ionization chamber with E.T.1 electrometer triode.

(Rate of Galvo. Deflection (cm./sec.) vs. Variation in Strength of Radium Source. Galvo. Sensitivity 10 cm. per microampere.)

In calibrating the gauze ionization chamber use was made of the equivalent relation given by the British X-ray and Radium Protection Committee that the safe dose of 10^{-5} Roentgen per second is equivalent to 1 mg. Ra at a distance of 14·5 cm. This was used as a standard and all experimental results on gamma radiation related to it.

For the calibration of the evacuable ionization chamber it was desirable to know the ' radium equivalent ' of the tolerance radon dose of 10^{-11} Curie/litre. This may be calculated by the following method. Gray (private communication) gives the number of ion pairs formed in air by an alpha particle from radon in equilibrium with its decay products as $5\cdot52\times10^5$.

Hence the number of ion pairs emitted by 1 Curie radium per second is $3\cdot7\times10^{10}\times5\cdot52\times10^5$ ion pairs per second where $3\cdot7\times10^{10}$ is the number of α-particles emitted per second at equilibrium by 1 Curie radium.

Now 10^{-11} Curie/litre $=10^{-14}$ Curie/c.c.
and 10^{-14} Curie/c.c. $\equiv 3\cdot7\times10^{10}\times5\cdot52\times10^5\times10^{-14}$
$=204$ ion pairs/c.c./sec.

In a volume of 1 c.c. this degree of ionization will give rise to a current of $204\times4\cdot8\times10^{-10}$ e.s.u./sec. where $4\cdot8\times10^{-10}$ e.s.u. is the ionic charge and, by the definition of the Roentgen 10^{-11} Curie/litre is equivalent to $204\times4\cdot8\times10^{-10}$ Roentgen/sec.

It has been found * that 1 mg. radium at a distance of 14·5 cm. gives 10^{-5} Roentgen/sec. It was found convenient to use a 0·2 mg. capsule of radium for calibration and this was placed at a distance of

$$14\cdot5\times\sqrt{0\cdot2}\times\sqrt{\frac{10^{-5}}{204\times4\cdot8\times10^{-10}}}=65\cdot5 \text{ cm.}$$

* See Report of British X-ray and Radium Protection Committee (1943).

Hence 10^{-11} Curies per litre is equivalent to 0·2 mg. Ra at 65·5 cm.

This was the method used for calibrating the chamber and it is believed to be sufficiently accurate for the purpose of these investigations.

Another source of error to be taken into account was the question of saturation of the chamber. It is known (Klema and Barschall, 1943; Jaffe, 1929) that it is difficult to obtain complete saturation for alpha particles and measurements of current were taken over a voltage range 120–360 volts. No appreciable change in current resulted and it was therefore assumed that the ionization chamber was nearly saturated at 120 volts. This assumption was confirmed by subsequent correspondence with Mr. J. C. Jones of Middlesex Hospital, who has had very considerable experience of radon measurements.

Investigations under Working Conditions

The primary purpose of the work undertaken was to assess the safety of working conditions in the luminizing section of a large works.

Previous work undertaken to the same end had been carried out using, as a means of detection, first a simple gold-leaf electroscope and, secondly, dental films supplied and processed by the National Physical Laboratory at Teddington. The method described in this article was held to be more flexible in that it allowed beta- and gamma-ray measurements as well as radon measurements to be carried out with substantially the same apparatus, and it was also more accurate.

The room in which the measurements were made may be considered as representative of the best modern practice in the protection of workers against luminizing hazards. It was 32 feet long by 12 feet wide and was airy and well lit. There were ten booths in which dials were painted. Each one was so arranged that the worker was protected from the effect of beta and gamma radiation by the interposition of a sheet of lead glass between the work and the operative's face. Each booth was also separately exhausted in order to draw off any radon formed during work. Washing facilities were provided and also facilities for inspecting the hands under ultra-violet light in order to reveal the presence of luminescent material. Provision was made for the storage of materials and the disposal of contaminated waste, and protective clothing was provided.

Gamma radiation measurements were taken at various positions in the room, and at different times of the day and week. The results showed that at no time did the gamma-ray dosage in the room rise above 11·2 per cent. of tolerance, reaching a minimum of 5·6 per cent. under favourable conditions. Even when the measuring instrument was moved as close as possible to a booth when work was under way the dosage reached no more than 27·5 per cent. of tolerance.

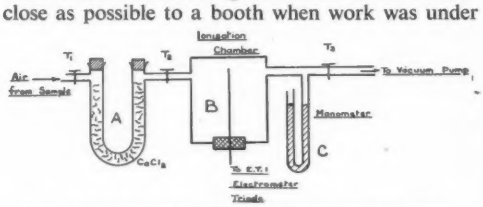

FIG. 7.—Schematic diagram of apparatus for determination of radon concentration in air.

Radon Measurements

In connexion with these measurements certain precautions were necessary. Referring to fig. 7 the process of filling the chamber was as follows:—

The system was evacuated up to the tap T_1. Tap T_2 was then closed and the sample of air of which the radon content was to be measured was admitted very slowly by opening T_1. The ionization chamber, B, was thus filled with the air from the sample. When the pressure, as indicated on the manometer, C, had reached that of the atmosphere, T_2 was closed and, after an interval of some minutes, measurements were taken. The necessity for admitting the sample slowly arises from the fact that, if this is not done, a spurious positive result is noted. This has been noted by other workers and attributed to the presence of moisture. The authors, however, consider that frictional charging of the incoming air might be a more likely cause.

Method of Collecting Radon Samples

In the case of measurement of the atmospheric and exhaled radon the ionization chamber was set up in the laboratory and the samples collected and transported in small latex rubber balloons. For the collection of atmospheric samples the balloons were inflated by means of a small hand pump and, in the case of the exhaled radon, the operatives were required to inflate the balloons. The exhaled samples were taken in the morning before the operatives had begun work and before they had entered the luminizing room. Ample time was thus allowed for the elimination of any radon inhaled from the atmosphere of the luminizing room (Curtiss, 1942).

Results of Tests

The measurements revealed, in all cases, that the concentration of radon both in the atmosphere and in the exhaled breath of the operatives were well below the tolerance limits, varying from 5–60 per cent. tolerance. An interesting point in these results was that there seemed to be no direct relation between the length of time an operative had worked in the luminizing room and the radon content of the exhaled breath. This would seem to point to the fact that, even under ideal conditions, a careless worker might conceivably fall victim to this industrial hazard.

A Simple Ventilation Calculation

It is useful, at this juncture, to consider the necessary rates of air flow which will, in given circumstances, keep the atmospheric radon concentrations down to the tolerance level. By making a number of simplifying assumptions the calculation becomes elementary.

Firstly we must consider the emanation of radon from luminous paint. The luminous powder contains 70 microgrammes of radium per gramme of powder. Radium evolves 2·1 micro-Curie radon/sec./gramme, but owing to the slow diffusion of the gas through the varnish used to bond the powder we assume the 'emanating power' of freshly applied wet paint to be 30 per cent. and that of dry paint to be 20 per cent. (Hemeon and Evans, 1942). Hence one gramme of wet paint evolves

$$\frac{30}{100} \times 2{\cdot}1 \times 10^{-6} \times 70 \times 10^{-6} = 4{\cdot}41 \times 10^{-11}$$

Curies/g./sec. and dry paint evolves $2{\cdot}94\times10^{-11}$ Curies/g./sec.

Taking, for example, the luminizing room dealt with in this article which measures 32 feet × 12 feet × 12 feet high and assuming no movement of air, we find that 90 grammes of dry paint, which is a maximum quantity stored in the room during working hours, would take

$$\frac{32\times12\times12\times1728\times2{\cdot}54^3\times10^{-3}\times10^{-10}}{2{\cdot}94\times10^{-11}\times90}\approx82\text{ minutes}$$

to bring the air in the room to a level of 10^{-10} Curies/litre. Thus, allowing a factor of safety of two, the air in the room should be changed every 40 minutes.

Applying the same method to an individual booth of approximate volume 4 cubic feet and containing under working conditions about 5 grammes of wet luminous compound, we find that the paint emits $4{\cdot}41\times10^{-11}$ Curies/sec./gm. which would bring the air in the booth to a level of 10^{-10} Curies/litre in

$$\frac{4\times1728\times2{\cdot}54^3\times10^{-3}\times10^{-10}}{5\times4{\cdot}41\times10^{-11}}=51{\cdot}4\text{ sec.}$$

Allowing a factor of safety of two the air in the booth should be changed in about 25 seconds, necessitating an air flow $4\times\frac{60}{25}=9{\cdot}6$, say 10 cubic feet per minute.

These simple calculations, although not accurate, serve to present an estimate of the ventilation needed for protection against radon concentration in the atmosphere.

Summary

The industrial hazards arising from the use of radioactive luminous compound are briefly reviewed and the tolerance limits fixed by British and American authorities summarized.

A short description of the ionization chambers and associated electrometer circuit is given and methods of calibrating the chambers are discussed.

Investigations carried out in a specific luminizing room show that the working conditions in the room are safe but it is found impossible, by means of measurement of radon in the exhaled breath, to correlate the length of time worked in the luminizing room with the radon content of the breath. This leads to the conclusion that personal habits of the operatives, even under the safest working conditions, may be the determining factor in the maintenance of health.

A simple calculation of ventilation requirements is given for certain idealized conditions.

Acknowledgments

The authors are grateful to Dr. T. E. Allibone and Mr. F. R. Perry for their interest in, and encouragement of, this work; they are also grateful to Mr. J. T. Thornhill for providing facilities for the work. Thanks are due to Sir Arthur Fleming, D.Sc., C.B.E., Director of the Research Department, Metropolitan-Vickers Electrical Company, for permission to publish this paper.

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CLINICAL EFFECTS OF TETRYL (CE POWDER) *

BY

H. B. TROUP

From the Royal Ordnance Factory, Bridgend

These observations are compiled from the findings and opinions of all the medical officers at R.O.F. Bridgend. No claim is made that the ideas are original; in fact, much of the material is common knowledge in filling factories, but tetryl has been used to a larger extent in this than in any other filling factory and it is thought that opinions based on this wide experience, whether new or not, should be recorded.

The problem at R.O.F. Bridgend has been all the greater on account of: (1) The large number of workers in contact with CE, approximately 5000. (2) The wide distribution of CE throughout the factory; of 13 sections, 6 were always CE sections, 4 more had CE shops often on the section, and only 3 were entirely free from CE contact. (3) The very large labour turnover in the factory during the past two years. (4) The large intake of ageing men in this period.

CE powder has been the main cause of loss of work in this factory, chiefly owing to dermatitis which it produces. Some workers complain of respiratory and gastric trouble, but these conditions are of minor importance in comparison with the skin affections.

CE Dermatitis

The Rash

The type of rash differs in individuals and in the areas of the skin affected. The clinical types are as follows:

(1) *Erythema.* Erythema affecting the face and neck; this may look exactly like a mild sunburn. In a fair number of cases this clears up and gives no further trouble after treatment.

(2) As in (1) but the rash becomes very dry and scaly. These cases are much more likely to recur when put into contact again.

(3) As in (1) and (2) plus slight or very marked oedema of the eyelids. These cases are never able to go into contact again; in fact, many are so sensitive, that even a visit to the works surgery (outside the contact area) will produce a recurrence, and it may be necessary to visit them at home.

(4) As in (1), (2) and (3) plus conjunctivitis. These cases are never able to go into contact again.

(5) A more papular patchy type of rash seen on the neck, shoulders and forearms with a tendency to lichenefication.

(6) *Sensitisation.* When a patient has become really sensitised a rash is liable to appear at any time on any area of the skin, usually face, back of neck, forehead, behind the ears, on the wrists. This has no relationship to his particular occupation and appears no matter where, and on what job, he works. In some cases it spreads generally on to the trunk and legs. Even if there is no rash on the body there is frequently marked irritation of the perineum.

(7) All the 6 types mentioned above vary from extreme mildness to extreme severity.

Treatment

It is seldom any good treating these cases when they are still in contact; they are much better right away from the powder and all irritants, because when the skin becomes sensitive to CE it also seems to react more easily to other irritants even although they may be non-contact substances.

The applications used vary with the individual but generally lot. calamin. oleosa is best for the face, and ung. calamin. et boric. for the coarser rash on the neck, shoulders and wrists; on the other hand, some prefer the ointment on the face and others say that it irritates and prefer ung. sed. Those patients who complain of a burning feeling rather than an irritation get more relief from liq. alumin. acetat (B.P.C.); if this is too drying it can be alternated daily with lot. calamin. oleosa with good results. If there is a weeping area, which often occurs on the back of the neck and behind the ears, siccolam 3 parts and lanolin 1 part is very satisfactory. Treatment to a great extent is individual and symptomatic and therefore follows ordinary dermatological procedure.

Cause of the Rash

It is quite clear that personal idiosyncrasy to tetryl is the primary cause of the rash; all other causes or so-called causes are merely secondary or, one might say, provocative. Such secondary causes are:

(*a*) *Lack of personal cleanliness.* The worker may be dirty by nature. She may not make use of ablution rooms through laziness or because she wants to get off contact in order to get away from someone she does not like, the over-looker for example, or to join friends who have already been taken out of contact. These are not uncommon reasons; in fact it is a frequent experience to find

* Tri-nitro-phenyl-methyl-nitramine. The contraction CE stands for 'compound, exploding,' and is used throughout the paper as a synonym for tetryl.

that a batch of girls will for no apparent reason produce a rash and they will try to stick together wherever they go.

(*b*) *Careless use of barrier substances.* Used carelessly through laziness, or for reasons as stated in (*a*).

(*c*) *General health.* The worker's general condition, mental and physical, will affect susceptibility. Innumerable instances of this can be given. A particular instance is the emotional factor; this seems to have been the precipitating cause in a young married woman who had worked in CE for three years without developing a rash, but developed an acute CE dermatitis very soon after hearing that her husband was missing after air operations.

(*d*) *Sex, hair colour and skin lesions.* It is probable that some commonly accepted rules of selection require revising. Our experience is that CE rash is more frequent and far more severe in the male than in the female. Probable reasons for this are that the male skin with its hair is rougher and more likely to collect and hold powder; shaving removes the top layer of horny scale cells and exposes the more sensitive cells beneath to come into contact with the powder; in a woman the make-up (which most of them use) acts as a barrier; CE has no particular preference for reds, blondes or brunettes.

Skin lesions need not necessarily be regarded as a bar to CE contact; acne vulgaris, extensive scarring following burns, and pigmentation changes do not increase susceptibility and do not add to the gravity of a rash after it is acquired. Even psoriasis has been exposed with impunity to CE over long periods, but seborrhoea certainly, and most other skin diseases, are regarded as factors which must exclude from CE contact; so also is a dry scaly skin, the type of skin which is labelled ichthyosis in its more obvious form, for here a most intractable CE dermatitis can arise.

It is probable that in view of what is to be said later of the systemic effects of CE, selection should take greater cognizance of alimentary disorders than has been the custom.

Effect of Environment

The distribution of the rash and the severity depends to a certain extent on the type of work being done. Work with CE may include putting pellets into paper cartons which tends to spray the powder on to the face (see figs. 1 and 2). Hand stemming is more likely to affect the hands or the wrists. The general cleanliness of the shop has an effect on all this which can be shown by testing the air for powder concentration * and comparing the rash incidences.

It seems that the incidence of rash is higher in winter than in summer. This is contrary to earlier conceptions that rash was more prevalent in hot weather, but it is probably explained by the fact that shop doors are kept wide open in the summer with consequent better ventilation.

The incidence rate on the Pellets Section (see figs. 1 and 2) is three times as high as it is in the rest of the factory, but correlation between incidence rate and concentration of airborne CE is distorted by the impingement of other factors. For instance, the incidence is consistently highest in the Wrapping Shops, though the air concentration of CE has been six times higher in the Press Shops and three times higher in Bag Stemming Shops than in the Wrapping Shops. This is probably due to the fact that newcomers to the Pellets Section and those returning to contact, i.e. the 'susceptibles' were allocated to the Wrapping Shops. So, also, incidence was high in the Pool Shop where CE air concentration was low, but irritant solvents (naphtha and spirit) provided an additional hazard. Recurrence rate was cut when those returning to contact were no longer drafted direct into the Pool Shop.

The Eyes

CE conjunctivitis may be due to gross contamination (rubbing the eye) but is more commonly due to airborne CE. It is usually, though not invariably, accompanied by a CE rash of the face and will often persist for a long period after the rash has subsided. Irido-cyclitis and keratitis have occurred as a direct sequel of CE conjunctivitis. Sensitization may be extreme in conjunctivitis and in some cases a visit to the factory surgery has sufficed to give rise to an acute relapse.

Respiratory Tract

The respiratory effects of CE are difficult to assess but it is accepted that tracheitis and asthma do result from exposure to CE. The ex-miner who has been certified as suffering from silicosis or pneumokoniosis is excluded from CE contact, but the lesser disability or reticulation has proved to be no bar to work in contact with CE.

Alimentary Tract

The main symptoms of gastric disorder due to CE are nausea and anorexia, pain being a less common and later symptom than in the case of TNT gastritis. It is thought that although gastric disorders are less obvious with CE contact than in TNT contact, gastric symptoms are, in fact, not uncommon. That this should be so might be expected from the similarity in molecular structure of CE and TNT.

In this connection we had two cases of jaundice in which the toxic effect of CE though not proven cannot be entirely eliminated.

Case 1. M. W. Age 24; in contact with CE from 18.11.41 until 28.9.43, when she went sick. She was out of sorts since September 1943, complaining of nausea and epigastric pain, which became worse on 26.9.43, and jaundice was noticed on 29.9.43. She was admitted to hospital for investigation on 4.10.43, and it was reported that the urine contained an excess of urobiligen, urobilin and bile pigment and that the Van den Burg gave a negative direct and a positive indirect reaction; the opinion expressed was that it was difficult to disprove the possibility of a toxic factor in causing the jaundice.

* The maximum allowable atmosphere concentration of tetryl (CE) is 1·5 mg./m.^{3} It is believed that there is no health hazard at this concentration. (*Manual of Industrial Hygiene* (1943). Ed. by W. M. Gafafer. W. B. Saunders Company, p. 264.)

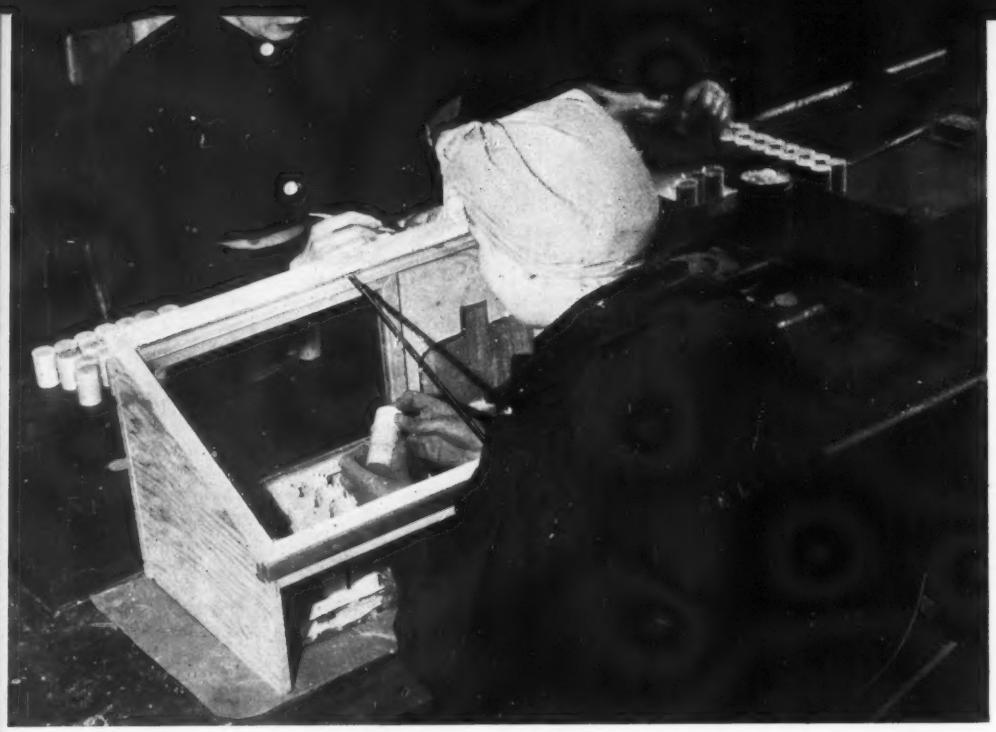

FIG. 1 (above).—Inserting pellets of tetryl (CE powder) into cartons. Note the protection against dust provided by fixed glass screen—the ' lighthouse.'

FIG. 2 (below).—Team packing cartons of tetryl. Another view of the ' lighthouse ' showing its protective value against tetryl dust.

Case 2. B. D. Age 22; worked in the factory from 9.6.41 until 24.5.43; in contact with CE much of the time but never in contact with TNT. She died following clinical symptoms of toxic jaundice and the post-mortem findings were atrophy of the liver with distortion of the upper parts of the liver. After leaving the R.O.F. she had worked at a factory where she handled closed containers which had been filled with chlorinated naphthalene.

Prophylaxis

The main factor in prevention is personal cleanliness and shop cleanliness. Prevention can be attained by the following measures.

(1) Personal

All workers in CE Sections are given the factory booklet which sets out the objects of personal prophylaxis and the means by which it is carried out.

(*a*) *Barrier substances.* The most satisfactory are the varnishes, particularly Manucol, a sodium alginate modified for our requirements, and selected as a barrier on CE Sections; it was chosen because it forms a quick-drying cohesive pellicle on the skin surface. Sulphite soap is also provided, in tablet form, which is effective and more readily accepted than liquid soap by the workers. Whichever barrier is used the application requires instruction and supervision. It is applied before starting work and again in the break. The application before the break should be washed off at the break and reapplied before work is again commenced. This should be washed off at the end of the shift. Clean towels should be used at each washing and a special receptacle kept for the dirty towels. Creams are not considered to be very satisfactory as they tend to collect the powder.

(*b*) *Hair protection.* This is most desirable but seems impossible to achieve. The various headdresses last for a day or two but the female instinct for adornment and attraction prevails and 'the curls will out.' Hair protection is of considerable importance because if a person sensitized to CE is living in the same house, the powder carried home in the hair will produce a rash in that person. This has occurred on a number of occasions here and the only thing to do is to take the whole household out of contact; as there may be several persons living in the house who are working on contact this may have a considerable effect on production.

In order to establish routine measures it has been made the responsibility of the factory nurses to supervise personal prophylaxis of those who are in the Training School and also of those who have returned to contact. Other operatives are the responsibility of the production staff, who must be left in no doubt of this responsibility.

(2) In the Shops

CE rash is much more commonly due to airborne CE than to direct contamination and no great progress will be made in reducing the incidence of CE rash until extract ventilation is installed at the site of the operations, e.g. gridded tables with down draught. The problem of extract ventilation is complicated by the explosive risk but it can be carried out safely by induced draught and, however great the difficulties, it should be installed in those factories where there are widespread CE processes.

The following measures were carried out in this factory with the object of minimizing the incidence of rash:

(*a*) The spread of CE operations on to so many sections made it impossible to remove effectively from contact those who were very sensitive to CE and in a number of cases removal from contact did not prevent progressive deterioration and eventual permanent unfitness for contact. To overcome this difficulty a special shop was opened on a part of one of the remote non-contact sections and transfer to and from this shop was effected on the recommendation of the medical officer if he considered the worker to be too sensitive to be dealt with in the available non-contact sections. Clean, light jobs were done in this shop and the majority, though not all of those who worked there, were reconditioned at least to work on non-contact sections. It is important that a filling factory in which CE is widespread must have sufficient sections which are strictly isolated from CE Sections, i.e. without common cleanways.

(*b*) A sub-committee of the factory safety committee did excellent work and helped to instil a sense of urgency in the production management.

(*c*) Shop ventilation in winter months was improved by the provision of plywood inclined baffles inside the louvres, whereby incoming air was directed upwards and operatives no longer needed to stuff up the louvres.

(*d*) Squads of cleaners were detailed to the sole and constant duty of cleaning the CE presses.

(*e*) The use of a specially designed 'lighthouse' (see figs. 1 and 2) was made compulsory during the insertion of pellets into cartons; this certainly reduced the airborne CE which had been previously puffed up into the face of the operator.

(*f*) Later the 'lighthouses' were dispersed as widely as possible in the Wrapping Shops and operatives worked as isolated small teams instead of being bunched along a table.

Summary

Tetryl (known colloquially in Royal Ordnance Factories as CE) is a potent cause of dermatitis. This occurs mainly as erythema of the face.

Clinical effects on other parts of the body are insignificant.

Personal idiosyncrasy is the main causal factor. Contributory or secondary factors are lack of personal cleanliness, careless use of barrier substances, poor general health.

The rash is commoner and more severe in men.

Skin lesions of any kind are a bar to contact with this substance.

Prevention is not difficult and consists of personal and shop cleanliness. Health propaganda, barrier substances, hair protection and adequate shop ventilation and guarding by 'lighthouses' are important measures.

MONOCYTOSIS AS AN INDEX OF TNT ABSORPTION

BY

ALISON M. HAMILTON *

During the performance of routine full blood counts on men and women workers in a Royal Ordnance Factory handling trinitrotoluene (TNT), a rise in the absolute number of large mononuclear leucocytes (monocytes), was frequently observed. It was hoped that the presence of this rise might indicate early toxicity and so help to decide whether gastric or other symptoms in such a worker were due to TNT, or merely coincidental. Webster's urine test is useless for this purpose, since it merely indicates the excretion of TNT products, and not whether the patient is poisoned.

To test this hypothesis further, four groups of workers were taken and examined:

(i) Fifty-four workers in contact with TNT with gastric symptoms or other symptoms known to be produced by TNT intoxication, such as tightness in the chest, pallor and fatigue, and anilism (slatey-blue cyanosis).

(ii) Fifty-one workers in contact with TNT with no symptoms.

(iii) A hundred and two normal controls.

(iv) Forty non-contact cases with gastric symptoms.

Methods

In all cases a full blood count (including reticulocytes) was done in order to keep a check on the occurrence of any abnormality which might invalidate results.

Most of the patients with symptoms (contact and non-contact) were bled in the laboratory at the main surgery. A large number of the non-complaining contacts were done at the branch surgery on their own factory ' group,' and many of the normal controls (largely office staff) at work.

The blood used was capillary blood taken either from the lobe of the ear or from the thumb at the root of the nail, and the films stained by Leishman's method. In performing the count two hundred cells were always counted.

For the reticulocyte counts a small quantity of capillary blood was mixed with an equal volume of 20 per cent. brilliant cresyl blue in normal saline and incubated at 37° for fifteen minutes. Films were then made and stained by Leishman's method.

For brevity in the text all monocyte counts are referred to as ' high ' if the absolute figure is above 450 per c.mm., those below this being considered not to be raised. This figure was chosen after careful study of the ranges taken by a number of workers (Price-Jones, Vaughan and Goddard, 1935; Whitby and Britton, 1944; Todd and Sanford, 1941). The figure 450 proved to be greater than the mean actually observed in the normal controls in the present series.

* Late Pathologist and Assistant Medical Officer, Royal Ordnance Factory, Aycliffe, Co. Durham.

Results

When the investigation was completed, final analysis of the results showed a statistically significant rise in the two groups in contact with TNT, and none in the two non-contact groups. In the case of the complaining group, the mean was 730 and in that of the non-complaining, 722. The standard deviation of the means were respectively 360 and 305. In the normal controls, on the other hand, the mean was 228 with S.D. 86, and the non-contact gastric subjects showed a mean of 291 with S.D. 130. It is to be noted that both the non-contact groups had the maximum of their range below the 450 chosen in the experiment as an arbitrary normal level. (The results are summarized in Table 1.)

TABLE 1
ANALYSIS OF RESULTS

Category	Number of cases	Mean monocyte count	Standard deviation of mean
Showing symptoms	54	730	360
Not complaining ..	51	722	305
Controls (normal)	102	228	86
Gastric controls ..	40	291	130

It was clear that workers in contact with TNT, whether with or without symptoms, tended to have high monocyte counts, and so it was not possible to use this test, as had been hoped, to differentiate toxicity from coincidental disease.

In order, however, to determine further that the monocytosis was really due to TNT, thirty cases were followed up which had showed monocytosis during contact and who had been taken off contact. Owing to absence or discharges only ten of these were examined at sufficiently regular intervals to be satisfactory material. The results of these examinations are given in fig. 1. It will be noted that in these cases the count falls to normal two months after removal from contact, and that the level then lies approximately between 200 and 300. The previous finding of a rise due to exposure to TNT was thus confirmed.

It was also found that gastric and other symptoms when present tended to subside at about the same rate as did the monocyte count, or rather more rapidly.

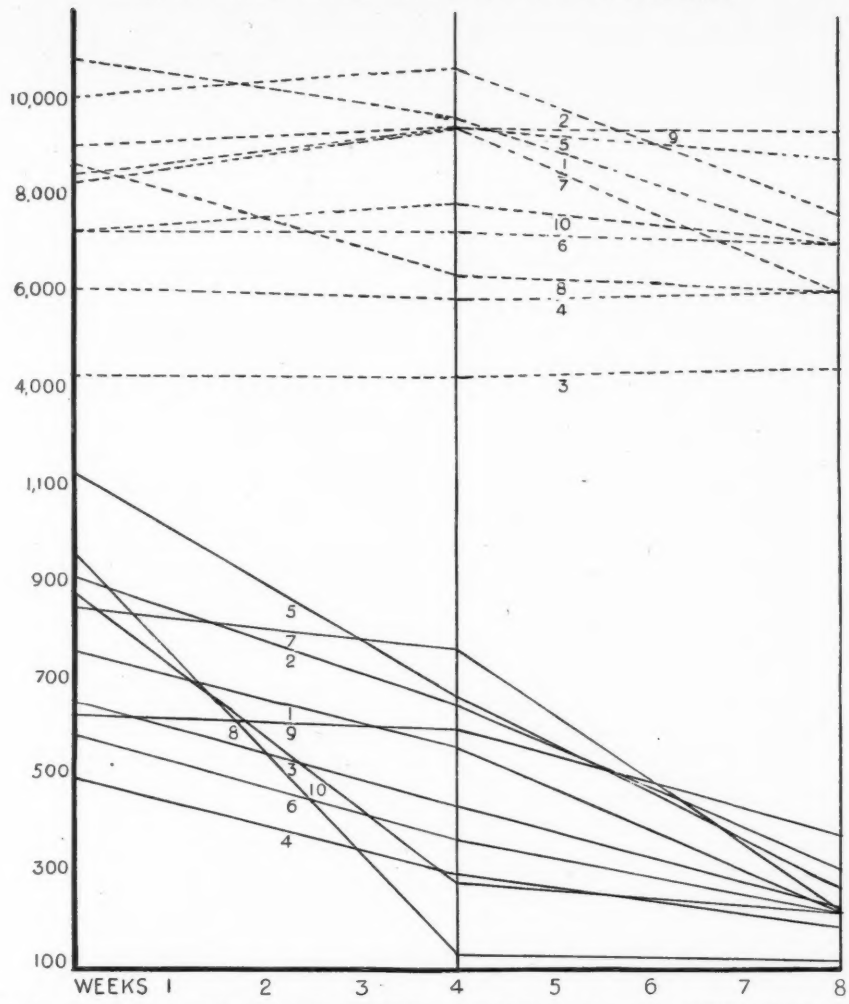

FIG. 1.—Monocyte counts (continuous) and W.B.C. counts (dotted) in ten cases of TNT poisoning one month and two months after removal from TNT contact.

Further, it was observed that the intensity of the response was not proportional either to length of time of exposure or to heaviness of contact, and this fact has been noted by other workers in connexion with TNT jaundice and aplastic anaemia (Livingstone-Learmonth and Cunningham, 1916; Moore, 1917).

In a series of eight of the workers showing symptoms who had been in contact for periods ranging from two to six weeks, the mean monocyte count was 615. This is below the mean for the whole of that group (730), but above the figure 450 chosen as an upper limit of normality in this investigation. On the other hand, a male operative who had worked with TNT for ten years (one of the series in the non-complaining group), had a monocyte count of only 304.

Intensity of contact was not so easy to assess, owing to the variety of operations and the tendency to change workers from one process to another. In the present series there were, however, two cases, both complaining of symptoms, who were on work in which contact was known to be light, and they had monocyte counts of 644 and 860 respectively. Furthermore, of the series of fifty-four workers with symptoms, nineteen were inspectors and not operatives, and the manual contact with TNT was, in their case, considerably less than it was in that of the operatives in the filling shops. Of these nineteen, sixteen had monocyte counts above 450.

Discussion

Previous work on TNT has been largely directed towards its toxic effect upon liver and bone marrow (Livingstone-Learmonth and Cunningham; and Moore). When the circulating blood has been

examined it has almost always been with reference to the count of the red blood corpuscles, the haemoglobin percentage and the polymorph-lymphocyte ratio (Panton, 1921; Stewart, 1917; Cone, 1944). An eosinophilia has sometimes been noted (Stewart; Cone), but in the hundred TNT contacts under review at present only sixteen showed an absolute eosinophil count above 250. With regard to the polymorph-lymphocyte ratio, only six in the series had a lymphocytosis. Twenty-two had a mild leucocytosis of over 10,500, fourteen of these having an absolute increase in polymorphs. (In deciding the upper limit of normality, the criteria suggested by Kracke (1941) were adopted: normal range of polymorphs 3000–7000; of lymphocytes, 1000–4000).

The reticulocyte response to TNT absorption has also been studied (Davie, 1941; Stewart, Witts *et al.*, 1944) and a reticulocytosis has been found to occur which is at its peak a few days after removal from contact. No reticulocytosis was ever observed in any of the present series while in contact, although cases were examined whose periods of contact varied from two weeks to ten years. There were no facilities for examining them when just removed from contact.

With regard to a monocytosis in the presence of TNT, almost no reference could be found to it in previous work. There was only a passing mention by Browning (1944) to its variable occurrence. A definite monocytosis has, however, been observed in the presence of the allied substances aniline and benzene, and with tetrachlorethane, and was first noted by Malden (1907) in aniline workers. Selling and Osgood (1938) noted a rise up to 7 per cent. in a series of twenty-eight cases in contact with benzene, and Smith (1928) in a series of seventy-nine women, records similar findings. In the case of tetrachlorethane, Hunter (1944) quotes Minot and Smith (1921) as having found an increase up to 40 per cent. in workers exposed to this substance, and Parminter (1921) as using this monocytosis as a test of early poisoning among such workers. Beck (1938) also notes tetrachlorethane poisoning as a cause of monocytosis.

If, as is suggested by Beck, the chief cause of a monocytosis is foreign matter in the blood-stream such as degenerated cells, it seems possible that there may be a monocytosis in response to an exogenous poison which on absorption, even in minute quantities, damages the liver and bone marrow cells. This may occur when the concentration is such as can easily be dealt with in the otherwise healthy organism. Kracke mentions that a monocytosis has been observed in subacute infections, where the toxin is, obviously, endogenous and occurring in relatively small and steady amounts. Monocytosis, therefore, whilst occurring in the presence of TNT absorption, is not considered to be a specific response, but incidental only.

Conclusion

From the above investigations it appears that contact with TNT causes a rise in the monocyte count, irrespective of the presence of symptoms, and that neither heaviness of contact nor length of exposure seems to be the determining factor in the intensity of the response.

Clinically the test is useful when it is desired to differentiate between a real TNT gastric syndrome persisting after removal from contact and similar symptoms due to other causes occurring in those who have recently been working with TNT but have been removed to non-contact work. It remains positive for several months, and therefore can be used to show the presence of absorption effects long after Webster's test would have become negative.

Summary

A study of a hundred and five individuals exposed to a TNT hazard and of a hundred and forty-two individuals not exposed to TNT has shown that an early reaction to TNT poisoning is a rise in the large mononuclear leucocyte count.

This rise is reversed within two to three months after removal from TNT contact.

The monocyte rise appears usually to precede any symptoms of illness and seems likely to be an early physiological reaction to TNT.

It is suggested that this monocyte rise may be of use in the differential diagnosis of TNT poisoning.

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MEDICAL SCIENCE AND PHYSICAL EDUCATION IN INDUSTRY *

Nutrition and Diet

Since nutrition is basic to welfare, the subject is of first importance for industrial workers. Provision for regular meals must therefore be considered. There are arguments in favour of workers returning home or taking meals out as a respite from the works atmosphere and for the sake of a change of companionship. These naturally vary with the individual, his home conditions, his earnings, the distance between his home and his work and other factors. Industrial canteens and adequate food services must, however, be provided for workers in the mass. The more attractive the environment, the better the food, and the more efficient the service the more will the beneficial effect on general health be evident.

Various bodies which do valuable work should be given assistance in tackling problems and instituting further research into matters such as the suitability of the food provided for different classes of workers, whose diet should be consonant with the energy output demanded by the particular type of work; the provision of special diets for workers with digestive disorders, such as chronic gastritis, colitis, peptic or duodenal ulcer, etc.; the adequacy of the time allotted for the luncheon 'hour'—more often than not it is half an hour; the advisability of taking a heavy meal at midday or in the evening. These and a host of other questions equally pertinent to welfare arise in studying the industrial worker's life.

The Canteen Service

Number of Industrial Canteens. In June 1944, the Ministry of Food gave the figure as 17,178; of these 5844 canteens were for heavy workers and 11,334 for other industrial workers.

The Chief Inspector of Factories' Report for 1943 contains comprehensive information on canteens. This report gives a total of 11,535, including docks and building sites. Of this total 5704 were in factories employing under 250 workers, which shows the interest in establishing canteens apart from statutory obligation, as firms employing under 250 workers are not covered by the Canteen Order 573, April 1943, although canteens voluntarily established are subject to inspection by the Factory Department.

Extension of Services Provided. Besides the growth in numbers the extension of services provided for day workers is notable. Many official morning and/or afternoon breaks have been introduced and beverages and sandwiches and cakes made available either from trolleys, kiosks or in the canteen. Unofficial breaks are also more widely accepted. This factor has made a definite contribution to physical well-being as it supplements an inadequate breakfast. The Ministry of Food recognize that owing to the bulky nature of war-time food it is better to have a number of small meals rather than fewer large ones. The available proteins are used more economically by the body if distributed in this way.

Shift Workers. Provision made for workers on eight-hour shifts has improved. Sometimes a typical dinner is asked for by shift workers, but in other factories a substantial snack is preferred.

Meals for Juveniles. There has been a marked increase in the number of special schemes for workers under 16 or 18. There is some tendency to stop special privileges on the 16th birthday. The importance of food on physical development between the 17th and 19th years should be more widely stressed. A *National Milk Cocoa* scheme was introduced in November 1943, for industrial workers under 18. In September 1944, the age limit was extended to 21, and supplies were also made available for youth clubs and similar organizations.

Special Diets. Adequate provision of special diets in canteens has received some attention, but this is a field in which much will be done in the near future. The established schemes have proved their value. Closer co-operation between doctors, hospital dietitians and canteen managers is essential to the successful development of this service. The difficulty of making a patient stick to a diet is constantly noted.

Food Tastes. Local tastes and customs persist strongly, and should never be ignored by anyone seeking to influence food habits. Customers tend to expect a standard of food that cannot be achieved with available food supplies. Surveys of various sorts (nutrition, food consumption or values) have been made by several bodies, including the Ministry of Food, Institute of Statistics, National Council of Social Service, and individual firms. Patronage of the small canteen is far better than large ones. The percentage taking a main meal tends to be higher when the proportion of office employees is high.

During war time values were maintained by substituting available foods for those which became scarce. In certain large firms raw vegetable salads have played quite a large part on the menus, and items like bovril have been added to the soups provided for the junior workers. Much educative work has been necessary to popularize the less common dishes, and good results have been obtained.

Improvement in Standards of Accommodation. The importance of rest and relaxation during meal breaks is becoming more widely recognized. Some attempt to brighten canteens by pictures or murals has been made. Entertainments during dinner-time have been extended. Restrictions on purchases have set a limit to what many firms are anxious to do.

Administration. Most canteens have carried on in the face of really grave staff shortages, and often without suitably trained or skilled cooks, assistants or managers. Training courses to attempt to remedy this have lacked recruits, but as the pressure of war work is reduced, it is hoped this position will improve. It is desirable to have some registerable qualification for dietitians employed in canteens. Lecture courses on nutrition have had a remarkable success, showing the desire of canteen managers to understand this aspect of their job. The need for further instruction in kitchen hygiene and staff control is often apparent, and it is hoped these matters will receive further attention shortly.

Direct assessment of the value to health and general welfare is not possible. Isolated examples could be given of firms attributing low absentee figures in part to the canteen service being available during blitz periods. Also, some employers attribute more effective resistance to infection to the good meals taken in the canteen. It would be a disservice to research to quote these exceptional cases in a general report. The trend towards improving facilities and establishing canteens in the post-war factories is, however, pronounced; and this is an encouraging feature to all interested in nutrition and national health.

* A Report published by the Research Board for the Correlation of Medical Science and Physical Education (1946). Ling Physical Education Association. Hamilton House, Bidborough Street, London, W.C.1. Pp. 88. 2*s*.

The Report (published here in abbreviated form) was prepared by a sub-committee of the Research Board, under the chairmanship of F. A. E. Crew, F.R.S., D.Sc., Ph.D., M.D., F.R.C.P.

Job Analysis, Job Specification, Vocational Selection, Vocational Guidance

For the establishment and maintenance of health and general well-being of the worker, as well as for the attainment of optimum production through the display of maximum efficiency on his part, there is nothing of greater importance than that there shall be harmony between the individual concerned and the task to be performed. Much disability and much inefficiency derive from the strain that results when an individual is employed in a job that demands attributes that he does not possess and from the frustration that is created when he is so occupied that his abilities are not fully or appropriately employed.

For the establishment of this harmony it is necessary that there shall be teamwork between employer, employee, doctor, psychologist, welfare supervisor and physical educationist. Such teamwork, based on scientific job analysis and personnel selection, on human understanding and sympathy, can help in no uncertain way in the provision of congenial employment suitable to the mental and physical attributes of the worker, and is essential to health, happiness and efficiency.

The scientific procedures of job analysis and personnel selection are the fruits of studies that have been undertaken in recent years by industrial psychologists both at home and abroad. In this country the Industrial Health Research Board and the National Institute of Industrial Psychology have been particularly active and have played a notable part in the designing and elaboration of systems of job analysis and specification, of personnel selection and vocational guidance.

Developments in the Services

These systems, adopted in this country before the war by a few progressive industrial and commercial organizations, have been further elaborated and refined and intensely and extensively used by the fighting Services, to which problems of man-power conservation and utilization quickly became paramount when the total resources of the country were mobilized for war. These Services, being faced with the overwhelming task of transforming, with the utmost speed, raw civilian human material into highly skilled warriors able to use a wide variety of most complicated weapons and instruments, were forced to pay great attention to such matters as the description of employments in terms of their demands in respect of certain human qualities: e.g. intelligence, educability, literary facility, constructional aptitude, sociability, forcefulness, leadership, carefulness, perseverance, general stability and physique; and to the selection from among Service personnel of the types best suited in virtue of their qualities, for the various kinds of employment that are to be encountered within the Services.

Teamwork between representatives of the various arms and branches of the Services, doctors, industrial psychologists, psychiatrists, and physical training instructors, has been the means of placing many hundreds of thousands of men and women in their war-time employments in the Services by methods which have shown themselves to be thoroughly justified in that they have reduced sickness generally and man-power wastage, and have demonstrably raised the efficiency of every group that has been exposed to them. Moreover these methods, regarded initially with a certain suspicion, became increasingly popular as it came to be recognized that they led to a more comprehensive and fairer appraisal than did those they replaced.

When it becomes possible to publish the results that have been obtained by the Services during the war there will become available for general application in industry and elsewhere, knowledge that will undoubtedly prove to be of the greatest possible value to employers of labour and to organizations which are concerned with the selection of trainees for the professions and trades. Moreover, the selection procedures of the kind that have been devised by the War Office Selection Boards for the screening of potential officers will then become available for the systematic recognition of appropriate candidates for various high-grade types of occupation.

It is to be expected that in the immediate post-war years there will be a great increase in the application of this personnel selection of attitude surveys (the reactions of the employees to work) and of such procedures as time and motion studies of jobs in order to eliminate discomfort and wasted energy, and that for these purposes there will be required a considerable increase in the number of industrial medical officers and psychologists, welfare officers and physical educationists in the industrial field.

Job analysis and job specification deal with the definition of the nature and the description of the various kinds of undertaking, and of their requirements in respect of human attributes. In addition to the obviously necessary information about the job itself, the kind and availability of opportunities for learning and following it, the qualifications obtainable in it and the prospects it offers, the analyst and selector must also know what specific human physical capacities it demands, what preliminary educational qualifications or previous occupational experience, for what range of intelligence it is suitable, for what special aptitudes it calls, and what kind of an individual, in respect of disposition, it best suits.

The techniques used must of course differ to some extent according to whether they are being employed to improve methods and purposes, as a basis for the training or transference of employees, or for the purpose of protecting the health and safety of employees. Nevertheless the basis is essentially the same for all analyses.

Selection by 'Pulhems' Assessment

Personnel selection is the sorting out from amongst a general population of those individuals and types suitable in virtue of their possession of certain kinds of talents, temperaments and acquired skills, for employment in various kinds of jobs. In the Services the individual is considered in respect of the following qualities: physique or general constitution; upper limb efficiency; lower limb efficiency; hearing; eye efficiency; mental capacity; stability (emotional). It will be noted that initial letters of these headings form the synthetic word 'Pulhems.'

Each of these seven qualities is assessed in one of five degrees, No. 1 being the highest assessment. The figures entered on the Pulhems card of any given individual form a profile and this profile is matched with that of the demands, in terms of these qualifications, of each and every employment in the Services.

It thus becomes possible through job analysis and specification, through vocational selection, i.e. choosing the man for the job, and through vocational guidance, choosing the job for the man, to ensure as far as is humanly possible that each and every individual is recommended for posting to an employment which is in harmony with his or her personality, previous history and potentialities.

This system has played a very important part in the replacement and reinstatement of disabled individuals in the Services. In compiling the Pulhems profile of any individual serious consideration is given to the question as to whether or not any quality which is assessed at a low rate can be improved by remedial treatment. It is here that the specialists in physical medicine and the Army Physical Training Corps make their special contributions.

It is probable that in the near future analyses of all industrial employments similar to those of Army employments will be made possible under the auspices of the Ministry of Labour, through further expansion of the activities of such bodies as the National Institute of Industrial Psychology and through the further development of schemes of vocational guidance for boys and girls leaving school under the auspices either of reorganized local education authorities or of the Ministry of Labour.

In this way it can be expected that the misfit who results from the placing of too heavy a strain on modest ability or from the non-recognition of latent talent and its employment in unsuitable ways will become rarer.

Recreation

There are no figures on which to estimate the exact percentage of companies which provide recreative facilities for their workers. Experience, indeed, would suggest that in only a small number of factories is such provision normally made. It is true that certain firms have comprehensive educational schemes which provide for the recreative as well as for the intellectual needs of employees; some have a wide range of indoor and outdoor recreative facilities, while certain large firms allow satellite factories in their area to use their grounds. In addition to the facilities arranged by these factories, the Ministry of Labour make some provision for transferred workers, and local clubs, hostels and other institutes offer opportunities to a considerable percentage of workers. For example, the Ministry of Labour Welfare Department have set up 130 clubs for transferred workers, e.g. as established at Swindon for 1000 to 1500 members; and in October 1944, had 16 others in preparation. Other types of workers' recreational clubs flourish throughout the country and are given special facilities by the Board of Trade and the Ministry of Labour to purchase games equipment. The report on the provision of special clubs for young workers by an investigator, commissioned by King George's Jubilee Trust to survey the whole field of adolescent activity, shows that a few firms had undertaken this, but that such provision was rare.* This deficiency is partially counterbalanced by efforts on the Ministry's part or by the long-established work of the voluntary organizations on behalf of industrial workers. At the same time neither the provisions of the Government nor of voluntary bodies relieve firms of their particular responsibility for the welfare of their employees, nor excuse the fact that, considering the wide field of industry and the millions of human beings involved, the total sum of facilities provided from purely altruistic reasons for those millions in need of recreation from arduous tasks is lamentably inadequate to the need.

What really emerges from a survey of the position is that there is no general arrangement for recreation in industry as a whole. Certain large and small firms have through their own enterprise initiated schemes, there are certain sporadic—and sometimes spasmodic—Government projects, and there are the more permanent facilities of the voluntary organizations, in the shape of clubs, recreation centres, evening institutes, etc. (to whose value the Government provisions for youth service should materially add); but there is no compulsion on employers to see that their employees have opportunities for recreation; nor hitherto has there been any genuine co-ordinated effort between Government departments to meet this need. Yet experience shows that the contented worker is the best worker and that adequate arrangements for welfare result in better health and better output (though the latter should not be a primary consideration). Indeed, for the sake of common humanity, if there is to be a differentiation between man and machine, the industrial worker should be given full opportunity to indulge in rest or recreation, mental or physical, of a type entirely different from the often monotonous and automatic labour of the workshop or factory.

Interesting experiments in ascertaining the effects of regular physical education among selected groups of juvenile workers, details of whose health and capacity for output have been statistically compared with those of corresponding groups of controls, have been carried out by the Ministry of Education in co-operation with firms such as Messrs. Mather and Platt, Manchester, Messrs. Montague Burton, Leeds, L.M.S. Railway, Derby, and Messrs. Albert Gill, Ltd., Teme Valley Trading Estate. A clear distinction, however, should be made between the use of physical education in its recreational and occupational aspects. The latter has its value in that it enables the worker to produce the greatest effect with real economy of effort; whilst the former is directed towards the happiness and health of employees, which should be the foremost consideration.

The educational and welfare schemes of many industrial firms have been affected by war-time conditions. Some have been partly or wholly suspended. Others have been kept in existence. Some have maintained their welfare services as far as possible, although 50 per cent. of their premises have been requisitioned by Government departments and 50 per cent. of their employees withdrawn for service in the Forces or in more essential industries.

The Ministry of Education issued in 1944 a pamphlet on community centres which contains recommendations concerning canteens, social, educational, outdoor and general activities. The pamphlet stresses the need for variety according to the type of neighbourhood served, the centre being made for the community and not vice versa. It is stated that the justification for spending public money on a community centre must be that it performs a public service in which the social, recreative and educational aspects merge. Suggestions are made for organization in different kinds of areas.

Miners. Recreational facilities are provided largely by the Miners' Welfare Fund, instituted by Act of Parliament in 1920. This fund derives its income from a statutory levy of 1*d.* per ton on saleable coal and a royalties levy of 1*s.* in the pound on mining royalties. This is administered by the Miners' Welfare Commission and is used for various purposes, including the provision of parks, recreation grounds, buildings for reading, billiards and gymnasia.

A point which here emerges is that where voluntary organizations flourish locally the task of industry in its welfare schemes should be not to compete with those organizations, but rather to support and to co-operate with them.

The Central Council of Physical Recreation. As an example of grant-aided provision for recreation in industry, the work of the Central Council of Physical Recreation serves to show the potentialities of an organized service which could profitably be extended. This work is still in its infancy but it covers a wide curriculum of purposeful physical training, recreation proper, and fitness camps and holiday centres.

If progress is to be made, the Council consider—

(*a*) That more research is needed. There is a wide field for experiment in the whole subject of movement as one of the important factors in the attainment of positive health. In industry, the special subjects for research are perhaps relaxation, remedial exercises, physical compensation, and training in correct and economical movement.

(*b*) That firms must be safeguarded from the insufficiently trained amateur. It is essential that firms' physical recreation officers should be supervised and have the benefit of suitable refresher courses. There is yet very little application of physical education principles in the industrial world. The Central Council have done, however, considerable pioneer work in this field, and would seem, therefore, particularly if they continue to receive grant-aid from the Ministry of Labour and National Service, the appropriate body to guide and set a standard for physical training and recreation in industry. It is impossible at this juncture to foresee with certainty the best means of forging a link between the Council and firms, but a contributory scheme can be envisaged whereby interested firms could gain, for a sliding scale of fees to the Council, service in varying forms and degree, e.g. literature, advice, supervisory visits, part-time or full-time staff.

(*c*) That suitable leaders must be trained. First, physical education specialists should keep themselves up to date in measures directed towards the development of physical recreation in industry and special training in welfare. Second, young welfare officers should be given

* A. E. Morgan, *The Need of Youth*, Oxford University Press, 1938.

an insight into and some training in the leadership of recreative activities. In this way, firms unable to employ full-time leaders of physical recreation could have either a welfare officer able to help with physical recreation or a physical educationist competent to assist with welfare.

If suitable Service physical training instructors either before or after demobilization could be given training based on the application of their physical training knowledge to industrial work and some special branch of welfare, they would be valuable members of any factory staff. Their qualifications would be assured and maintained by their link with the Central Council.

(*d*) That it should be made possible for the Central Council of Physical Recreation to arrange experimental schemes, perhaps of three months' duration, in factories whose managements, although interested, are not yet wholly convinced as to the need for providing physical training and recreation for their workers.

Holiday Provision

Trials have been made during the war years to stagger holidays internally in large organizations, among them the Ministry of Supply, but this practice has virtually been abandoned. The majority of firms prefer to close their works for a week, the main reasons given being the need for cleaning, repainting and maintenance and the fact that a shortage of workers over a long period often breaks up a team and production is affected much more adversely than by closing the entire factory for a week. Certain industries with continuous processes, however, prefer internal staggering, and they often have to make their arrangements by rota. Clerical staffs of offices also come under this heading.

Occupational Health Services

Industrial medicine is no new form of medical practice in Great Britain. In the early days of the industrial revolution a few factory occupiers with a high sense of duty appointed medical officers to attend to the needs of their workpeople. But they were isolated examples and the only comprehensive provisions made to eliminate some of the worst evils of industrial life were the Factory Acts, designed in the first place to safeguard women and young persons from unbridled exploitation by textile manufacturers. These Acts were gradually extended to cover other types of industry and all classes of labour. To-day the Factories Act, 1937, and special regulations to protect workers in certain trades provide comprehensive legislation laying down minimum standards to guard the health, safety and welfare of those who come under that Act.

British industry is made up of a variety of trades and occupational groups such as factories, docks, railways, shipping, road and air transport, mines, quarries, constructional work, building, agriculture, forestry, Government service and commerce. Factories are by far the biggest group, employing in peace time over 6,000,000 workers. It is no surprise, therefore, that both through the public services and voluntary effort more has been done to promote health in factories than in any of the smaller industrial groups.

Health Workers in Industry

At the end of 1943 there were 174 medical officers exercising full-time supervision in 265 factories, and 774 attending part-time in 1150 factories. By October 1944, the full-time officers had increased to 179 and the part-time to 880.

In August 1943 there were approximately 8385 nurses employed in industrial nursing. About half were state registered, the remainder having 'lesser qualifications.' *

* All the above figures relate to factories and other places of work coming under the Act. They do not take into account the medical officers in mines, railways, shipping, Post Office and telegraphy, and those engaged whole-time on research which, according to a report by the Education sub-Committee of the Association of Industrial Medical Officers, employ altogether a further 349 medical officers, 300 of whom are in the Merchant Service. No figures are known for other health workers employed in these industries and occupational groups.

Personnel and Safety Officers

In January 1944 the number of factories in which more than 250 persons were employed carrying on work which might bring the factory under the Order of 1940, was 4774. 'Special officers, who might be called personnel managers or welfare supervisors are employed in 3395 of them, and the total number so employed in this is 5478.' There are safety officers engaged in factories.*

Deficiencies in Existing Services

While much progress has been made since the war, there are, nevertheless, certain outstanding deficiencies in these arrangements. It is estimated that not more than 25 per cent. of industrial workers are provided for adequately as regards health services at work. In Great Britain, and incidentally in other countries, it must be stressed that the majority of workers are employed in the smaller industrial organizations, and that factories, although employing the major proportion of workpeople, do not include all industries which need health services at work. Because of the recent development in industrial medicine, Government departments, private bodies and privately owned industries have experimented with their own arrangements for a service. The lack of co-ordination is obvious, but it is also found in Government administration. The Ministry of Labour administer the Factory Department, the Ministry of Fuel and Power their own mines medical service, the Ministry of War Transport make arrangements for dock workers, and the Ministry of Supply provide a separate medical service for Royal Ordnance factories. This has led not only to technical and administrative overlapping, but also to inadequate co-ordination of function.

Future Development. The existing industrial medical services have recently been examined and reported on by the Social and Preventive Committee of the Royal College of Physicians. The recommendations of this committee stand out as the only authoritative and constructive suggestions for the future of industrial medicine which have so far been made. They conclude that an industrial health service should be national in its scope and apply to every variety of employment, and that it should be planned as an integral part of the National Health Service with arrangements for close association at all levels, central, regional and local, with other branches of the National Health Service. Quoting from this report the reasons which led the committee to adopt these views on this organization are briefly as follows:

(i) The health of the individual at home and at work cannot be rationally separated;

(ii) It would be impossible to secure efficient rehabilitation, unless there were the closest link between the two services;

(iii) The development of the National Health Service on sound lines requires direct access to the wealth of knowledge accruing from observations of health in industry;

(iv) The new industrial health service must spread its influence far and wide into work which is more closely associated with home and family than the factory.

Objectives of Occupational Health Services

These suggestions can go a long way to meet the difficulties in the existing organization of the service, by co-ordinating existing arrangements, and by providing for the small factories which at present have no service at all. But the rapid development of occupational medicine has allowed many different conceptions of its function to arise; partly because many industrial medical officers have received little or no training for this type of practice. There are those who think that its sole function is to prevent industrial disease, while it is well recognized that industrial disease causes only a fraction of the total morbidity of the industrial worker. There are even others, including doctors, employers and workmen, who regard the industrial medical officer as the guardian of the employer's interests—censoring panel

doctors' certificates. Thus an understanding of the objectives of occupational medicine is no less important than plans for its future administration.

The aims of an occupational health service should be as follows:

To recommend suitable work for every worker

The suitability of a man, woman or young person for a particular type of work depends both on his or her physical and mental ability. Many firms have long used medical examination of workers before employment. In Great Britain there is no statutory requirement for the examination of new employees except for young persons under the age of 16 employed in factories and certain requirements for the examination of workers in dangerous trades. Before the war the pre-employment examination was accepted by many, but others, particularly the trade unions, looked upon it with suspicion, and some opposed it in no uncertain manner. This attitude is understandable because medical examination could quite easily be used by those firms with their own medical service to pick the best workers and leave the unfit out of work or to find jobs in the smaller factories. However, during the war, many of the large industrial organizations, notably the Royal Ordnance factories, who employ many thousands of workers in engineering, filling and explosive processes, have emphasized the need for placement of workers rather than rejection because of the shortage of labour and the need in war to make the best use of every available worker. If the examination of workers before employment is to be widely used, it is felt that this emphasis must be maintained. If used mainly for rejecting the less physically fit, it will naturally and rightly be viewed with suspicion by all workers and will be opposed by their trade unions.

Industrial medical services after the war will have a major responsibility in seeing that the disabled who return to work are absorbed satisfactorily into suitable jobs. Pre-employment medical examinations can help to meet this responsibility if their purpose is clearly defined as being to place the worker in the most suitable job from the point of view of his own health and his physical capabilities.

Mental capacity, also, affects a man's suitability for work. Tests for intelligence and special abilities, such as mechanical aptitude, have been used with effect in the Services, and there is no doubt that used with discretion by industrial psychologists they have a value in industry, particularly for guiding boys and girls towards suitable careers and selecting workers for skilled trades. The same principles apply to the use of vocational selection tests as to the use of pre-medical examinations. If they are used not too rigidly for allocating rather than for rejecting the less intelligent their scope will be enormous.

Special reference should here be made to the excellent work done in the directorates of personnel selection and army psychiatry, in which important research into fitting men into employment suitable to their mental as well as their physical capacity has been successfully carried out.

To provide every worker with a good working environment

Much of the preventable sickness which affects workers is associated with poor housing, economic stress and lack of education. Nevertheless, the working environment can greatly influence the health of the worker, quite apart from those special diseases peculiarly attributable to industry, such as lead poisoning and pneumokoniosis. A good working environment can only be attained by careful and prolonged study of groups of employees at work. This study can be undertaken by special investigators and by medical officers and others in their own factories. The latter have the advantage of being in constant touch with day to day problems, but wholetime research workers can deal with national health problems and others with which factory personnel are unable to cope. In this way those factors associated with increased morbidity and lessened efficiency can be determined, and these harmful influences eliminated by the combined efforts of doctors, engineers, chemists, managements, workers and other technicians. Thus can minimum standards of health be raised.

To prevent occupational disease

At work a man may contract disease as a direct result of the hazards inherent in his occupation. Lead poisoning, from which, among many others, the house painter or those working at electric accumulator factories may suffer, can be quoted from many examples of industrial disease. But industrial disease is preventable and should therefore be prevented by industry and its health services who must accept responsibility for its incidence. Nevertheless it should be emphasized that industrial disease and accident cause only a fraction of morbidity among industrial workers. Undoubtedly the main contribution which industrial health services can make to better personal health and less disease is by paying attention to general conditions of work and the vocational suitability of the individual worker.

To prevent injuries at work

Industry in general deals with accidents largely from the point of view of providing first-aid treatment for major injuries and continuous treatment for minor ones. And lately a few industries have made a forward step in assisting injured workmen to regain full function after injury by providing rehabilitation shops and special centres. These are important aspects of the accident problem which cannot be ignored, but insufficient attention has been paid to the prevention of accidents. Although the law requires that dangerous machines in factories shall be guarded, the bulk of accidents are not due to unsafe machinery, so however satisfactorily the Factories Act is enforced, accidents will not be reduced substantially unless attention is given to the training, supervision and placing of workers in suitable jobs, and particularly to the enforcing of good working conditions. It has been shown by scientific investigation that the temperature and lighting of workshops are related to the incidence of accidents, and from prolonged and frequent study of accident records that certain workers are accident-prone and should be put on to safe work. There is great opportunity for health services in industry to assist in reducing the accident rate in factories and mines.

To treat injured and sick workers at work

In 1938, the last full year before the war, there were more than 511,879 accidents in factories and mines alone involving absence from work of more than three days. This represents a considerable loss of production to the country and of wages to the worker. The total loss due to industrial accidents in Great Britain has been estimated at £70,000,000 per annum (Mr. Ernest Bevin, *The Times*, 25.4.45). Recovery where the injury is serious and the speed with which the worker recovers depend very much on the first treatment received. So it is in the interest of all industries with an accident hazard to provide good casualty services for the first treatment for medical emergencies and minor medical ailments not serious enough to prevent the worker from working.

To help workers to regain full function after injury and disease and to assist in the resettlement of the permanently disabled

The speed and degree of recovery of an injured or sick person depends primarily on the surgical or medical treatment given at home or in hospital. The publicity given lately to rehabilitation is a general appreciation of the need for a wider use than hitherto of improved methods of treatment practised for many years by a few enlightened physicians and surgeons. War makes heavy demands on man power and the exigencies of war are mainly responsible for the medical profession being obliged to adopt new criteria for measuring the success of their therapeutic methods. These new methods are designed to restore full function to the injured or sick as

soon as possible so that they are fit to do their usual work and earn full wages.

In co-operation with physician, surgeon or general practitioner the industrial medical officer can play an important part in achieving this aim. He can help to find graded work for those who are not permanently disabled but who have reached a certain stage in recovery until they are fit to resume their usual tasks. Under the joint supervision of the surgeon and the industrial medical officer machines can actually be adapted for remedial use in certain types of injury. This has been done very successfully by the Austin Motor Company, who have established a sheltered shop solely for this purpose. The industrial medical officer can also keep watch on those who have returned to work after a long period of disablement, and determine whether they are fit for their work and where necessary help to restore self-confidence. Recent studies in the U.S.A. (Johnson, J. F., *J. Am. Med. Assoc.*, 1944, 126, 1073) show what the industrial medical officer can do to help 'G.I. Joe' to resettle in industry. The author says a number of the men returning to civilian life would certainly have lost their jobs if they had been handled casually and without careful individual attention.

There are many permanently disabled for whom industry must find suitable work under the provisions of the Disabled Persons (Employment) Act. The Ministry of Labour have already adopted a scheme to implement this Act. The disablement rehabilitation officer in each area interviews patients in hospital before their discharge. He discusses both with the patient and his doctors the job the former wishes and is able to do. He obtains a medical report on the patient's disability and completes it by recommending future work for the injured or sick person. So far the industrial medical officer, who should have special knowledge of industrial processes and their functional requirements, has not been brought into the scheme. In fact he has been denied access to the reports prepared by the disablement rehabilitation officer. It is hoped that this policy will be changed, for he can give valuable assistance to the permanently disabled in two ways. Firstly, he can help the disablement rehabilitation officer to find suitable work for the disabled worker, for with medical knowledge he can understand the medical reports on the man's disability and by his knowledge of his own industry he can assist the disablement rehabilitation officer in placing the disabled. So as a medical practitioner with a knowledge of industrial processes he holds a unique position among sociologists. He can also assist in the rehabilitation of those who are unfit to take up immediately full-time employment or training. Under Section 3 of the Disabled Persons (Employment) Act, the Minister has power to provide special facilities for this class of worker. There will be many who will want to stay at home and not go away to the Egham experimental centre or a similar centre. They could quite easily be rehabilitated and retrained in some of the larger firms which have their own industral health. services. Another obvious advantage would be that they would be in contact with normal workers and day to day work-life. The industrial medical officer can also assess whether an injured man is physically suited for the work for which it is proposed to retrain him. One of the main obstacles in the path to full recovery is financial worry, which can be avoided by putting a man on productive work in a factory which provides him with a reasonable wage and treatment. For all these reasons the industrial medical officer has an important part to play in rehabilitating and resettling the injured and sick.

Ancillary Health Services

In the U.S.A. and U.S.S.R. some of the larger industrial organizations have polyclinics which provide facilities for medical advice and treatment usually given in this country by panel doctors and out-patient departments of hospitals and for mass-radiography. This is done in the interests of the worker. The advantages are many. It automatically links up the curative and preventive aspects of medical practice. It is convenient to the worker, who is therefore more likely to seek early advice. Such clinics can be better equipped than the surgery of any panel doctor because of the large numbers they serve, and they can also become centres for clinical and sociological research. They are, in fact, health centres established within an industry, and should be the subject of experiment after the war. This principle has to some extent been adopted by a few of the larger firms in this country, who because of the deficiencies in existing health services and for the convenience of their employees have set up under the guidance of their local medical officers ophthalmic, dental, foot, physiotherapeutic and ante-natal clinics in their own factories. Experience shows that they have received on the whole warm support from the workers, who pay for their treatment, which they receive in the firm's time. In some instances, the employer has subsidized the service, but if in the future there is any scheme for polyclinics in factories, it is strongly recommended that the employer should not be expected to give any financial assistance, other than allowing employees to attend during working hours. The possible loss to production would no doubt be more than repaid by less sickness absence and greater efficiency as a result of earlier and better medical attention. Industrial polyclinics should in no way interfere with the practice of preventive medicine. They should be adequately staffed by doctors and others working in collaboration with the industrial hygienists.

Health Education

Disease and ignorance have been described by Sir William Beveridge as two of the five giant enemies of human happiness. Disease cannot be successfully attacked by integrating and expanding our health services both within and outside industry unless something is done to eliminate its ally—ignorance.

It so happens that nurses and doctors in industry are in a position to provide workers with knowledge which will overcome the type of ignorance which encourages disease; and not only industrial disease. At pre-employment examinations workers can be told of any defects found and advised about treatment. For many this will be the first time that they have had a complete medical examination. They receive an introduction to the medical department, which they should be encouraged to use, as well as other facilities like washing accommodation and ambulance rooms. They can also be advised about making claims for sickness benefit and workmen's compensation. The factory is a suitable medium for showing films, giving talks, and health propaganda of all sorts. From experience it has been found that schemes for health education in industry are most successful where the workers themselves participate actively through factory health committees on which they are represented. The education of management and workpeople on health problems in industry is fundamental to any improvement in the health of our industrial population.

There is unlimited scope for publishing in attractive and readable reports the fund of knowledge gleaned by the various Government departments concerned with occupational health. Many reports have been published but so often they are badly produced, written in official jargon, and overloaded with complicated tables and data which no layman can understand. Sometimes valuable information is kept hidden in files and never sees the light of day. There is certainly need for scientific reports for scientists, but there must be a form of popular publication for the industrial manager and the workman, whose interest is essential if scientific knowledge is to be used to their advantage.

The Central Council for Health Education

The Ministry of Health grant-aid a body which is doing useful work in the field of health education. The Central Council for Health Education attach great importance to health education in industry and consider

the problem of being ' not quite fit ' much more important than the more obvious problem of sickness causing absence from work. This problem is common to all sections of the community and the factory offers an opportunity for reaching members of the public. The Central Council do not deal with industrial problems but aim at giving workers information which will be of help to them. Methods employed include talks, film shows, gramophone records, literature, posters and exhibitions which can include all the foregoing individual methods and be linked with education on the particular industrial risks to which the workers are exposed. More specialized education in preserving positive health can be arranged by means of courses for industrial welfare officers and nurses; and the Central Council also offer to deal with any problems submitted to their headquarters. It is desired that health education in the factory should be part of a campaign undertaken jointly with local authorities, managements, welfare officers and workers; and the Central Council have area representatives in twelve centres in England and Wales who act as organizers and are able to co-ordinate this work.

Education and Research

After the 1914–1918 war a small number of factory occupiers began to appoint their own industrial medical officers, but is was not until the middle of the 1939–1945 war that this number became substantial. It is only recently that medical science has been applied on any large scale to factories and other industries for promoting the health of workers. The principles to be adopted in its application are in many cases similar to those applied by medical men and women in the medical services of the armed forces, the public health services and in general practice. But the doctors and others whose task it is to promote health in industry are meeting problems arising in an environment which differs in so many respects from that at home and in Service life. Such problems cannot be countered without special training and without the guidance of research. An attempt has been made to meet the demands for educating medical officers and nurses by providing week-end courses at the London School of Hygiene and Tropical Medicine and at provincial universities in industrial areas. But the principles of industrial medical practice cannot be taught in half a dozen lectures, and it is a relatively small proportion of the industrial medical officers who attend these courses.

Better facilities for education can improve the status of occupational medicine and help to attain the objectives already outlined. They can be provided by those universities which will shortly have chairs and departments of industrial health and social medicine, i.e. Glasgow, Edinburgh, Manchester, Birmingham, Oxford and Durham, and others such as Cardiff and London as soon as the technical experts are available to provide the staff. Education in occupational health will be needed for the following groups: medical students, those who are already or wish to become industrial medical officers, nurses, factory inspectors, works managers, engineers and chemists, foremen, charge-hands and shop stewards. Teaching and research should go hand in hand, and the teachers in the university departments concerned with the health of the industrial worker should also be associated with research.

Rehabilitation

The term rehabilitation covers the physical, mental and social readjustment of a patient; his physical and psychological recovery, and his resettlement in work within the compass of his competence. Adequate medical rehabilitation, followed by industrial rehabilitation, means that the patient rather than the disease or injury becomes the chief subject of investigation and treatment, with a view to his restoration to that position in life in which he can make the fullest contribution and find the greatest satisfaction. This means, in other words, that instead of thinking in terms of disability our attention is increasingly concentrated upon the residual capacity of the disabled and on their competence to become useful and happy members of society.

Rehabilitation has been defined as ' that side of medical and surgical treatment which is concerned with the full recovery of mental and physical function damaged by illness or injury, and the restoration of the patient to his former occupation or his preparation for new employment better suited to his reduced capacity. Four principles are involved in this definition: (*a*) it is a medical process and part of the treatment; (*b*) it includes psychological as well as physical restoration; (*c*) it must provide a suitable alternative for the employee who can never return to his or her former job; (*d*) it does not stop at the hospital door but continues into industry.'

The team-work required therefore involves various members of the medical profession—surgeons, physicians, psychiatrists—nurses, physiotherapists, physical educationists, education officers, almoners, welfare supervisors, ministry officials, training-centre authorities and instructors, trades union officials, employers and the patients themselves. Only real and directed co-operation between these will bring about full rehabilitation of the individual.

In this report the question must primarily be considered from the angle of co-operation between the medical and physical education professions (and physical education must be interpreted here in its widest terms). It must also, however, be viewed in its general aspect, embracing not only the relation of the doctor and physical educationist—or re-educationist—to the rest of the team concerned, but also the fundamental aim of their co-operation, i.e. the happiness and health of the individual, which can only be achieved by social and industrial reinstatement corollary to mental and physical restoration. To dissociate any unit of the problem from its medical and sociological background would be unintelligent and unsound.

Types of Cases

Rehabilitation is not confined to cases of fracture or serious injury but is also applicable to all conditions in which there is loss of function or risk of residual disability resulting from illness or accident. The child with a congenital deformity—the boy with a burnt or lacerated hand—the young adult recovering from pneumonia or other serious respiratory disorder—the mother attempting to regain her strength after childbirth—the deaf and dumb and blind—the amputated—the chronic orthopædic or chronic heart case—the tuberculous and the neurotic—all such cases and many which are similar benefit enormously from suitable courses of physical and psychological rehabilitation, followed where necessary by special vocational training. Such treatment not only improves the patient's physical condition and expedites his recovery; it also affects his whole morale, and holds out before him a new hope of recovery and usefulness whilst at the same time stimulating his own powers of co-operation and self-help. That this is true can be proved by a visit to any hospital or centre concerned with different branches of rehabilitation, where first-hand knowledge is readily available.

Psychological Readjustment

The experience which has been gained during these past five years of war has drawn attention to the large part which mental anxiety and psychological disturbance can play in retarding physical recovery, and what is true of war-time conditions is also true in large measure during the days of peace. Anxiety about home affairs, anxiety regarding money, fear of losing his job or of becoming a permanent invalid or cripple—these factors all play a very large part in a man's or woman's recovery after serious illness or accident, and everything which can be done to restore confidence, to give reassurance and encouragement, and to call forth the patient's hope and co-operation form a most valuable part of rehabilitation. In the Army these functions have been carried out by

Army psychiatrists, welfare officers and educational officers, each of whom in his own way has been contributing to the process of psychological rehabilitation by scientific investigation of the cause of the mental disturbance, by the removal of sources of domestic and financial anxiety, and by providing new and healthy sources of mental entertainment and stimulus. In addition, special neurosis centres have been set up for the treatment and rehabilitation of patients suffering from psychosomatic disorders, such as effort syndrome, functional vertigo, atonic dyspepsia and similar conditions; and after a combination of careful clinical and psychiatric investigation and treatment, physical reconditioning, and suitable occupation, excellent results have been obtained.

Similar principles ought to be observed in our ordinary hospital practice in dealing with psychological aspects of rehabilitation. A certain number of cases—not, it is hoped, many in number, but cases which are easily overlooked—require the skilled help of a psychiatrist, but all cases of serious illness or injury should have the expert assistance of the social workers attached to the hospital, with a view to helping where necessary to alleviate anxiety and distress and smooth out any difficulties in connection with the patient's domestic or industrial affairs. For this kind of work the hospital almoner, with her special training in social science, and her long experience in dealing with individuals, is eminently fitted, but the pity of it is that so many important hospitals are still without the services of an almoner, and that where almoners have been engaged their time is far too often taken up with purely financial matters which could easily be dealt with by a clerk attached to the officer or the hospital secretary. Once it is appreciated that an essential part of rehabilitation consists in the psychological readjustment of disturbance created by illness or injury it will be obvious that almoners or similar social workers should be set aside for this task and given sufficient time to deal with each patient's case in whatever way seems desirable. The almoner must also be the effective link between the hospital staff and those representatives of industry and labour who will be responsible for the resettlement in industry of patients who are incapacitated from resuming their former occupation as a result of their disabilities. For that reason it is of the utmost importance that the almoner's department should have full knowledge of local industries and should keep in close touch with the disablement rehabilitation officer of the Ministry of Labour and National Service, who is responsible for interviewing patients likely to need vocational training and resettlement and who is now expected to make regular visits to the hospital for this purpose.

Industrial Resettlement

The setting-up, some three years ago, of the Interim Scheme, to deal with disablement problems as far as war-time circumstances allowed, led to the formation of the Tomlinson Committee in 1942 and the final introduction of the Disabled Persons (Employment) Act, 1944. *Industrial rehabilitation* is a term introduced by the Act. It signifies the provision of special facilities for those disabled persons unable immediately to enter full-time training or employment. An experimental centre for the purpose is established at Egham, Surrey, where the object is to combine the functions of reconditioning, physical development, restoration, vocational guidance and purposeful training. Industrial rehabilitation can also be carried out in co-operation with employers; the Ministry is empowered to provide financial assistance.

Vocational Training

This may be provided in Government training centres, of which there are 32, including coal-mining training centres, or in centres administered by voluntary organizations, grant-aided for the purpose. The Ministry has power also to grant-aid employers where the latter can provide the training direct. Both in schemes of industrial and vocational training trainees receive allowances, with supplementary allowances for their dependants. A further feature of the Act is that it obliges employers with 20 or more employees to employ a quota of disabled persons.

Co-operation between Medicine and Industry

Liaison between authorities responsible for medical rehabilitation and industrial resettlement is still far from assured. Industrialists and trade unions should be further awakened to the need of the disabled to obtain suitable employment and educated as to the possible employments which can and are being undertaken by them.

Service and Civil Centres

Further liaison should equally be established between those responsible for the rehabilitation of Service and civilian men and women. Plans for the adaptation of the excellent Service centres for civilian purposes should be drawn up and put into operation as soon as possible. The findings of the research which has been practised in those Service departments administering them should be made available, first and foremost to bodies such as the Medical Research Council and its constituent Industrial Health Research Board, and also to civilian centres which have not necessarily had the facilities nor the personnel available for such work.

The Substandard Worker

Rehabilitation of the substandard worker is as important as that of the more evidently disabled. The findings of the Research Board's Youth Service Panel and of the Services Committee with regard to the substandard condition of boys and girls of 14 plus and of Service recruits, and to the variety of major and minor defects needing remedial and sometimes surgical treatment, and the Research Board's recommendations for research into these matters and the establishment of juvenile and industrial physical development centres, modelled on the highly successful Service centres, need earnest consideration.

It is desirable that the idea of centres for the improvement of substandard workers should be correlated with general planning for rehabilitation. The problems can be dealt with simultaneously. The same health centre, the same medical organizer and supervisor, the same accommodation and equipment and the same ancillary technical staff could treat both types of cases and provide preventive and restorative measures. There is a certain danger that rehabilitation centres may be set up throughout the country, in connection with hospital and health centres, wholly concerned with the post-hospital aspect of rehabilitation, regardless of the equal importance of preventing ill-health and breakdown by the employment of the very same means as are devoted to the restoration of physical function. In this report the Research Board have a unique opportunity of drawing attention to this point and emphasize most strongly the need for direction in the planning of health and rehabilitation centres towards the dual function that such centres should discharge.

A further problem in the treatment of the substandard as well as the injured worker is psychological breakdown. The section on psychological readjustment which occurs earlier in this chapter deals more specifically with the psychological factor in cases which have already met with illness or injury resulting in hospitalization; it does not, however, deal with the even larger problem of the psychological misfits who continually report sick but never come to hospital and never consult a psychiatrist. The causes of their trouble, often enough personal and domestic problems, faulty job selection, uncongenial companionship, frustrated ambition and industrial fatigue, play a vital part as predisposing to absenteeism, accident-proneness and general breakdown, and are therefore of equal importance with physical disabilities as requiring preventive or curative treatment. Developments of such ideas as the Roffey Park Rehabilitation Centre and the Rest Break Houses scheme should all find their place in planning for rehabilitation.

A further type of case to be considered either as sub-standard or regrettably often as completely disabled is the patient who suffers from long-term occupational disease such as silicosis and pneumokoniosis. Often a return to the former occupation is so far impracticable as to be well-nigh impossible. Steps should therefore be taken to explore the possibility of making provision by village settlement or other appropriate means, when local surroundings do not lend themselves to rehabilitation.

Young Persons in Industry

The term 'young person' is now accepted to mean boys and girls of the 14–18 age-group, of whom there are approximately 2¾ millions in industry. To consider their welfare and the best methods of improving this it is well to recapitulate briefly the original historical facts of their employment and the steady improvement of conditions in the last 150 years.

The industrial revolution of the eighteenth and nineteenth centuries affected children even more adversely than their parents. Conditions, working-hours, the employment of very young children, starvation wages, lack of nutrition and lack of education were a crying scandal of which a record lives in the writings and speeches of reformers of political and literary fame, such as Shaftesbury, Peel, Owen, Dickens, Kingsley, Elizabeth Barrett-Browning. Not until 1784, when the revolution was well under way, do we find concessions made in respect of the health of children, when a group of Manchester doctors wrote: 'We earnestly recommend a longer recess from labour at noon and a more early dismission from it in the evening to all those who work in the cotton mills; but we deem this indulgence essential to the present health and future capacity for labour for those who are under the age of 14' with the result that the Lancashire magistrates refused to apprentice *pauper* children to 'owners of cotton mills and other works in which children are obliged to work in the night or more than 10 hours in the day.'

The Health and Morals of Apprentices Act (1802) forbade the employment of apprentices at night and for more than 12 hours in the day; and made the provision of elementary education, decent clothing and housing and the whitewashing of factories twice a year compulsory. It was followed by Robert Owen's Act, of 1819, which prohibited the employment of children under 9 in cotton factories and limited to 12 the working hours of children between 9 and 16 years old. In 1833 Lord Althorp's Act, involving the appointment of four permanent factory inspectors to enforce the law, affected nearly all the textile factories, forbade the employment of children under 9 except in silk mills, limited the working time of those under 18 to 12 hours a day and 69 a week, and of those under 13 to 9 hours a day and 48 a week, and forbade nightwork for all under 18. It enforced some education for all factory children, those between 9 and 13 attending schools for 2 hours on 6 days a week. It made illegal the employment by any mill-owner of children who had not completed 11 years of age without a certificate by a surgeon or physician and further enacted that any such child should be 'of the ordinary strength and appearance of children of or exceeding the age of 9 years.'

Lord Shaftesbury's work for children is memorable. In 1840 he set up a committee to investigate working conditions and in 1842 a Mines Act prohibiting underground work for women and for boys and girls under 10 was passed. Peel's 1844 Factory Act was a further advance. The age at which children could begin work was reduced to 8, but the hours were limited to 6½ and all factory children had to attend school for the rest of the day. It enforced the fencing of dangerous machinery and forbade its cleaning, when in motion, by women and children. It also introduced the appointment of certifying surgeons.

The culminating victory was the Act of 1850, introducing a 10-hour day for women and young persons; in the same year inspection of coal-mines was also introduced. By 1861, print works, bleaching and dyeing works and lace factories had all been brought within the scope of the Act, while the Workshops Act of 1867 covered all places employing women, young persons and children, forbade the employment of children under 13, enforced the half-time system for them and insisted on attendance at school for at least 10 hours during the week. The Consolidating Act of 1878 improved working conditions and brought all factories into alignment. It prohibited the employment of children under 10 and placed those under 14 on the half-time system. A Coal Mines Act of 1887 forbade the employment in mines of children under 12, enforced care of their health from 12 to 16 and laid down standards of safety, cleanliness and sanitation.

Such, roughly, was progress in the nineteenth century, and from it may be deduced that modern factory legislation really originated through reform of conditions for factory-children's welfare. To-day's Act affords protection for every type of worker and contains many sections for safeguarding young persons. The reforms had repercussions also on compulsory part-time education for children and, equally, on the establishment of state medical supervision.

Accidents

In any report concerning the health and welfare of young persons the accident-rate is of prime importance. The following table shows that the rate is higher among boys than among men and that the incidence of accidents among young persons is high and increasing.

Reportable accidents in factories	Boys	Girls
1936	24,299	8,191
1937	26,853	8,988
1938	22,922	7,803
1939	22,364	7,665
1940	26,492	8,493
1941	27,757	9,347
1942	29,028	10,493
1943	27,623	9,805

The drop in the incidence of accidents in 1938–39, shown in the same table, was probably due to :

(*a*) a decrease in working hours, involving less fatigue as well as a decrease in the time of exposure to danger;
(*b*) the tightening-up of safety regulations;
(*c*) the decrease in the number of young persons employed in industry owing to the reduction in working hours.

Accidents should not be inevitable. They arise as a general rule because of regulations not sufficiently widely or strictly enforced. The Factories Act provides general provisions for the safety of all workers. It prohibits young persons from cleaning machinery in motion; it ordains the training of workers before they use dangerous machines, and supervision by a skilled worker with knowledge of the machine. Guarding machinery is not enough. However well machinery may be guarded more than a 10 per cent. reduction in the accident rate by the provision of safeguards alone cannot be anticipated.

Training and Supervision

One of the solutions of the problem lies in training and supervision. It would be a great advantage if new entrants to the factory could be trained on a non-productive basis rather than allowed to pick up the technique of a new occupation in the ordinary course of production. Training schemes for simple industrial processes may appear to be wasteful of time in the initial instance, but ultimately they save time by turning out workers who are more productive and less liable to accidents. It is a short-term and short-sighted industrial policy which does not recognize non-productive time occasioned by

a growing accident rate. Various preventives are well worth consideration:

(1) Improved working conditions.

(2) Shorter hours and the enforcement of the law concerning these.

(3) Better selection of young persons for employment suited to their mental and physical capacity based on factors such as:

(*a*) vocational guidance;

(*b*) visual acuity;

(*c*) accident proneness.

(4) The provision of classes on causes and prevention of accidents.

(5) Film demonstrations at the factory and elsewhere.

(6) The formation of safety committees in the factories, through which boys and girls can learn a sense of responsibility and develop a cautionary sense and awareness similar to that developed in younger children by road-safety methods.

Medical officers can pay attention to all these matters and contribute with benefit to instruction in safety measures. The main improvements, however, are needed in factories where there are no medical officers—a further reason for recommending an increase in the low percentage of works medical officers employed. The introduction of instructors in physical education which involves development of agility and avoidance of accidents would seem more than desirable. Recent experiments in physical activity classes in which avoidance of accidents is taught have proved successful. Such instruction increases awareness and agility, and, while providing relaxation and entertainment is purposeful, in the extreme, to a very good end. An extension of such instruction is worthy of recommendation.

The employer cannot wash his hands of responsibility. In the past juvenile labour has been exploited for its convenience as a way of making money. It involves a heavy obligation on the employer to counteract the risks run by employing young persons; if he finds it convenient to use irresponsible labour he must assume an ultimate responsibility.

Hours of Work

There are certain legal requirements made by the Act which state that the weekly working hours shall be:

Under 16 .. 44 hours, except for a few trades where 48 hours is permissible.

Over 16 .. 48 hours, plus allowance for overtime.

For young persons a system of three shifts in certain trades is allowed.

Under emergency orders, however, these hours can be increased as follows:

Under 16	Day work	Weekly hours of work must not exceed 48.
Male young persons	3 shifts	Hours of shifts (including meal-times) to average 8 per day 6 days a week.
All young persons over 16.	2 day shifts	Hours of shifts, 8 per day between 6 a.m. and 11 p.m.
Male young persons over 16	2 day and night shifts and extended day work.	Hours of work not to exceed 60 per week.

Moreover, in the early days of the war these emergency orders were in many cases woefully exceeded, to the detriment of the young workers' health, and possibly caused an increase in accident rate, as is shown in the table on p. 35. The hours worked by young persons have now returned to a more normal level, but it is essential in the interest of the health of young British workers that in this respect factory law should be enforced; and those sections of the 1944 Education Act enforcing part-time education up to 18 put into operation as soon as possible.

Nutrition

The need for good nutrition of boys and girls is obvious to all interested in their health. There is a measurable improvement in the physique of elementary school children during the last twenty years owing to improved feeding and the recent provision of milk and meals in schools. In some 10,000 factories there are canteens; but they are not all used by young persons. Sometimes the price is too high. Many firms, however, supply free or subsidized meals. From experience it has been found that the adoption of a sliding scale based on a payment of 10 per cent. of earnings for five meals is well within the means of most young persons. Again the habit of eating sandwiches is still prevalent. This could be obviated by educating the parents to recognize the value of the canteen for their children. It would be worth while to give free meals for a week to effect this. The quality and quantity of the food, the appearance of the canteen, organization and speed of service are other important factors to consider. The co-option of a young person to the canteen committee would be advisable and help to extend interest. The canteen meal, properly organized, can provide one-third first-class protein, one-third total calories, two-thirds vitamins of total daily requirements.

Medical Supervision

The 1833 Act required surgeons to pass children, i.e. those between 9–13 years of age, as reasonably fit with the ordinary strength and appearance of a child of at least 9 years old. The powers of examining surgeons were gradually extended and the 1937 Act now in operation requires a medical examination by the examining surgeon of all persons under 16 years old within fourteen days of employment. Conditional certificates of fitness may be given, subject to conditions respecting the nature of the work, including a re-examination of the employee at an interval specified on the certificate. The value of this procedure lies in the fact that a young person is thereby allotted work within his physical capacity and that a follow-up scheme, limited though that is, is provided.

In certain circumstances a provisional certificate is given, lasting 21 days, during which time the medical officer can get more information about the fitness of the young person. In the case of boys between 16 and 18 years old employed on shifts in continuous processes, re-examination takes place every three months during the first year and every six months during the second year until the age of 18. This re-examination as well as the conditional certificate is not popular with some employers, but within certain limitations it is valuable from the point of view of the medical officer and the employee.

1939 showed that out of 400,000 young persons examined 13,000 conditional certificates were issued and 251 provisional certificates, pending the receipt of the school medical officer's report, i.e. 0·06 per cent. of the whole number examined.

The main objects of such medical supervision are:

(i) to find work suitable for the young employee;

(ii) to follow up all cases if possible; at least to follow up all suffering from defects, who are engaged in heavy or dangerous work.

A voluntary follow-up scheme in a large non-ferrous metal factory employing approximately 7000 workers, which was conducted for 18 months during 1937 and 1938 showed that out of 600 three were rejected, two suffering from gross mitral stenosis, one from epilepsy. Twenty-two were passed fit for special jobs. One girl with a history of chorea behind her, and suffering from mitral and aortic lesions, discharged from hospital under no medical supervision, was found a light sitting-down job where she thrived. If she had left she would either have been out of work or at work without medical supervision. This follow-up scheme proved the practicability of a high placement percentage and a low rejection rate when, through co-operation between the

medical and labour departments, suitable employment could be found for employees with certain defects.

Effect of Job on Physical Development

There is insufficient research into this pressing question, but medical officers often come across obvious examples of the bad effects of certain types of employment on posture, on feet, on internal organs—through heavy lifting—and on general health. No statistics have been taken in this country, but a survey taken among 412 children in the U.S.S.R. showed that 169 of them had faulty posture, 85 per cent. of the cases aggravated by the type of work in which they were employed. (*Occupation and Health*, I.L.O., Geneva, 1930.)

Among the causes of such defects are extreme fatigue, prolonged standing, unsuitable height of machinery, incorrect or too heavy weight-lifting, bad seating and too prolonged sitting on bad seats, bad lighting, etc.

Many of these causes are remediable and here the advice of doctor and physical educationist would be found invaluable. Bad lighting, bad seating and bad positioning of the machinery are comparatively easily rectified. Compensatory activities for prolonged standing or sitting, instruction in economic use of effort in operating certain machines, instruction in correct methods of weight-lifting are all within the purlieu of the physical educationist, who, more often than not a member of the Chartered Society of Physiotherapy, is qualified to give remedial exercises, under medical supervision, while posture classes, flat-foot classes and even individual classes could be arranged without undue loss of time and with a beneficial effect on cases with minor defects.

More attention should be paid to the teeth of young persons and better dental service provided. Similar attention should be paid to care of the eyes. In the survey previously mentioned which was undertaken in a non-ferrous metal factory, 153 boys and girls out of a total of 588 had obvious but uncorrected errors of refraction, 88 of these being gross cases. In this country, in 1939, examining surgeons rejected 1409 out of a total of 406,575 examined on account of diseases of the eyes and eyelids. The connection between bad eyesight or eyestrain and causation of accidents is obvious. Better services should be provided in this respect and the employees given sufficient time off to get proper glasses.

Education

Finally comes the question of education and vocational guidance. Roughly speaking, some 80 per cent. of our children receive elementary education only and leave school soon after their fourteenth birthday. These figures will be rectified by the raising of the school age under the new Education Act, 1944, and secondary education will be available to a much larger majority than formerly and part-time education compulsory until the age of 18. Sections 58, 59 and 60 of the Education Act deal with the employment of children and young persons and make provision for the prohibition or restriction of employment of children, especially in relation to employment prejudicial to their health or otherwise likely to render them unfit to obtain the full benefit of the education provided for them; and they make provision also for the effect of college attendance notices for attendance at county colleges on the computation of working hours and overtime.

As the Act is enforced, a resultant improvement in health and education should be seen, partly owing to the longer time spent at school, where provision for milk and meals is made and a longer period of education made available, and partly owing to the better control over the working hours of young persons who have to continue part-time education.

Vocational guidance should be given in the schools and better liaison established between the schools and industry. It should be made practicable for employers and industrialists to visit the upper forms of schools and describe the various openings in industry for boys and girls and for parties of senior boys and girls to be taken round a variety of industries or industrial exhibitions Liaison should be established between school authorities, including school doctors and organizers and teachers of physical education, industrial medical officers, parents, employers and the boys and girls themselves, with the object of arranging better vocational guidance for the last. It is even advisable to consider the special appointment of a careers or welfare officer for the purpose of effecting and maintaining such liaison. There should be especial co-operation between the school medical officer and the medical officer of the works to which the young employee goes so that work within his or her capability may be chosen and any physical or other idiosyncrasy provided for. In this choice the advice of the physical educationist could prove singularly helpful, but both the physical educationist and the doctor should acquaint himself or herself with the exact type of work in question, which can only be done in co-operation with the employer himself or his subordinates. Decisions as to whether an employee is fit or not fit to undertake certain work are only too often made without sufficient knowledge of what the work really is, apart from its generic title, of what physical and mental labour it entails, and of what provisions or modifications can be made to bring it within the competence of the would-be employee.

If any doubt is felt about the possibilities of improving the well-being of young persons in industry the recorded facts should be studied. A few concrete examples quoted from *Young Citizen* by A. E. Morgan may serve to illustrate these points:

(1) Boys of 17 years of age at Christ's Hospital School (1926–29) were on the average 3·8 inches taller than working boys (1929–32) of a similar age-group.

(2) In York in 1936 the average weight of boys of 14–16 in secondary schools was 8 lb. more than boys of the same age in the poorest groups in the community; among girls the disparity was 15½ lbs.

(3) The weights of school children of 5–14 years in the poorest groups, examined during the years 1899–1936, show an increase of 4·8 lb. for boys and 5·5 lb. for girls.

Our aim should be to narrow the gap between the boys and girls of these sections of the community and to make the higher level the common one. To this end team-work between administrators, industrialists, school authorities, works authorities, medical officers, physical educationists and all concerned with the welfare of young people can make the best and most effective contribution.

WOMEN IN INDUSTRY

There has been a recent trend towards fuller investigation into the work of women in industry, their value to industry, its effect on their health, their capacity for motherhood, their right to a more equitable scale of wages and to equal compensation. This is neither a political nor a feminist propaganda pamphlet. Facts speak for themselves, and with the growth of a better social conscience some of them at least will right themselves. Humanitarian as well as utilitarian principles should actuate the bettering of conditions for women workers as much as for men workers and young people.

Factory legislation which arose from the original need for reform in industrial practices in the nineteenth century affected women as well as children and young people. The 10-hour day movement, for which the struggle continued from 1784 to 1850, became law by the passing of the 1850 Act and reduced working hours for women and children. From the outset of the industrial revolution women had played an active part in industry. They have played it ever since. The years of war through which we have passed—and their aftermath through which we are now passing—have shown that the versatility of women can be turned to good account and that, while the majority of them may in certain ways be less physically strong than men, they have great

powers of endurance and great aptitude for adapting themselves to conditions and forms of work to which they have not necessarily been previously accustomed.

The Health of Women Workers

'The efficiency of industry and the well-being of the country depend very largely on the health of women workers.'

So runs a quotation from a pamphlet published in 1945 by the Industrial Health Research Board. If so, better provision should be made for preserving it. The majority of women have a dual role in life, which involves heavy mental and physical strain. They have their jobs in industry; they are also housewives and often mothers, and comparatively few of them return after working hours to homes where complete domestic and material responsibility has been lifted from their shoulders. Taken as a whole, women are of slighter physique than men, psychologically have less capacity for throwing off cares and a greater capacity for 'worrying,' and often find the cumulative anxieties of home and work an intolerable burden.

The Industrial Health Research Board pamphlet efficiently covers a number of causes for absence of women from work owing to health reasons, and should be studied closely. It would therefore be idle to recapitulate all the facts disclosed by the Industrial Health Research Board investigations. Certain of them should, however, be stressed for their immediate importance. For example, the report shows that an investigation covering five factories during the last six months of 1942 revealed that illness accounted for 10 per cent. loss of working time, i.e. one-half of the total time lost through absenteeism. A survey in 1942 and 1943 of the general trend of sickness over a longer period, involving 33,500 women, showed that on an average in 1943, 54 out of every 100 days' absence was caused by sickness or accidents. The chief causes appear to have been colds, influenza and other respiratory complaints, nervous and digestive disorders and fatigue; two-thirds of the total amount of time lost through illness was caused by only 16 per cent. of the women—conclusions similar to those reached by other investigations into sickness-absence in pre-war industry and also in war-time industry in Britain and the U.S.A.; which seems to indicate that special care and treatment of a comparatively small number of illness-prone women, in addition to adequate provision for the general health of women-workers, should lead to a considerable reduction of this percentage. Research into the various causes of absenteeism would be profitable; subjects suggesting themselves for immediate research should include diet, predisposition to certain types of illness and their causes, the effect of long standing or sitting, hours of work, different shift systems, etc.

Chapter I (Maternity and Child Welfare) of the three-part report *Medical Science and Physical Education*, published in 1944 by the Research Board for the Correlation of Medical Science and Physical Education, also contains paragraphs on environment at home and at work: its effect on mother and child, which are not inapposite in considering the health of women in industry.

'An important consideration affecting both mother and child is the influence of the mother's environment on the child in utero. Her house, the conditions of her work, her whole social background may well have some repercussions upon her child. It might be helpful to ascertain to what extent, if any, such factors as noise, long standing at work, mechanical work or work involving imagination, constant attention, and so on, may affect parent and offspring. Whilst the Factories Act (1937) and the Public Health Act (1936) contain provisions against the employment of a mother within four weeks after the birth of her child, they make no reference to any period of restriction before confinement. Further research might usefully be made into such problems as (*a*) the number of hours a woman in an advanced state of pregnancy should continue different types of sedentary or heavy manual work; (*b*) how near to her confinement she should continue work other than her normal domestic duties (again in relation to different types of work); (*c*) how long a period should elapse between confinement and return to work, i.e. whether the period at present allowed by the Acts is adequate. There is evidence to show that some employers already prescribe a longer interval. One large local education authority now requires notification of the expected date not less than three months beforehand and, as well as the statutory absence of four weeks before that date, insists on a further period of at least nine weeks after confinement before resuming work (or four weeks should the child not live); extension of the compulsory period may be granted on medical grounds.'

The whole of this chapter is indeed worthy of study in this respect; and, considering the anxiety to which mothers are subjected over financial considerations and the care of the children, the Research Board do not apologize for requoting a further paragraph from Chapter II, Part I, p. 18, dealing with nurseries, nursery schools and nursery classes, of the same report:

'For financial reasons it may be necessary for some mothers to seek employment at a time when, were their physical health the sole consideration, they would be well advised not to do so. This may also entail leaving their children overtime in nurseries. It is earnestly to be hoped that some means may be found, e.g. by family or other allowances, to relieve mothers of the burden of such a choice which affects the interests of family life and health.'

Physical Education for Women in Industry

As in the case of young employees, the effect of regular physical education for women during working hours is shown to be good in those firms which now employ regular physical education teachers. The activities include special training in correct methods of weight-lifting, posture-correction, correct methods of using machinery, and compensatory exercises after being in standing, sitting or cramped positions in factories, workrooms and offices; they also include recreative physical training, dancing, games activities, etc., and employers state that in no case have they found that the work suffers on account of the break. Rather the contrary. Indeed, such breaks are essential to the woman worker possibly even more than to the man worker. She is more frequently put to do utterly monotonous tasks, so that her brain becomes dulled and her body weary. Psychologically she needs a change of occupation more often than a man. Comparative research into the effect of active breaks on health and output might well show more active improvement among women than among men and boys.

Recommendations

NUTRITION AND DIET

(1) Provision for regular meals in works canteens should be made general.

(2) Employers should organize attractive surroundings and as attractive service in canteens as is possible in the circumstances for their employees.

(3) Every support should be given to bodies investigating dietetic values and the content of adequate meals for workers.

(4) More investigation into special diets for workers with digestive disorders should be conducted.

(5) Closer co-operation between doctors, hospital dietitions and canteen managers should be encouraged.

(6) Research into the effect of snack meals and heavy midday and evening meals should be encouraged.

(7) There should be some definite standard of registration for dietitians employed in factory canteens.

(8) The establishment of canteen committees should be encouraged.

(9) An extension of the national service hostels scheme should be carefully considered.

JOB ANALYSIS, JOB SPECIFICATION, VOCATIONAL SELECTION, VOCATIONAL GUIDANCE

(1) The knowledge distilled from the experiences of the fighting services in connection with job analysis and personnel selection should be conserved and steps taken to incorporate it in the affairs of industry.

(2) More co-ordination should be effected between organizations making a special study of, and advising on, job analysis, job specification, vocational selection, vocational guidance; and the advice of these bodies should be made more readily available to all types of firms.

(3) The number of works medical officers and welfare workers should be increased. The co-operation of physical medicine specialists should be sought. Firms should also employ experts in physical education.

RECREATION

(1) More research is needed into physical education in industry particularly with regard to relaxation, remedial exercises, physical compensation and training in correct and economic movement.

(2) The Central Council of Physical Recreation having already undertaken experimental work in this connection might deservedly be grant-aided to conduct further experiments.

(3) Suitable leaders of physical recreation should be trained. It is certain that with further training a number of ex-Service instructors would be suitable for this work. Although no guarantee of employment is expected, the appropriate Government departments should encourage suitable firms to employ well-trained men and women. The training of suitable leaders can be undertaken by the local education authorities, and by the Central Council.

(4) Industrial firms must be safeguarded from the insufficiently trained amateur, and to ensure that the firm's leaders of physical recreation should be supervised.

(5) Young welfare officers should be given an insight into some training in physical recreation.

(6) Further investigation into the question of holiday provision for industrial workers should be made.

OCCUPATIONAL HEALTH SERVICES

(1) An industrial health service should be planned as an integral part of the National Health Service.

(2) An industrial health service should be a co-operative undertaking with full support from both management and workers.

(3) Pre-employment medical examinations should be undertaken wherever possible.

(4) Such examinations should be undertaken with a view to placing the worker in the task most suited to his/her physical capabilities and not to rejecting him/her as unfit.

(5) The practice of providing rehabilitation shops and special centres should be extended.

(6) The establishment of polyclinics within industry should be the subject of experiment.

(7) Employers should not be expected to subsidize such service other than by allowing employees to attend during working hours.

(8) The education of management and workpeople on health problems in industry should be regarded as fundamental to any improvement in the health of our industrial population.

(9) The fund of knowledge gleaned by the various Government departments concerned with occupational health should be published in an attractive and readable form.

(10) Medical officers and personnel officers should have facilities for undertaking research.

(11) University departments and other bodies should assist such men and women with their research problems.

(12) The recommendations made by the Education Committee of the Association of Industrial Medical Officers in their report 'Education in Industrial Health' should be studied and put into effect.

REHABILITATION

(1) In any scheme of rehabilitation surgeons, physicians, psychiatrists, nurses, physiotherapists, physical educationists, education officers, almoners, welfare supervisors, ministry officials, training centre authorities and instructors, trade union officials, employers and the patients themselves should work together as a team.

(2) Rehabilitation should not be confined to cases of fracture and major injury, but should also be applicable to all conditions in which there is loss of function.

(3) The number of hospital almoners should be materially increased.

(4) Closer liaison should be established between authorities responsible for medical rehabilitation and industrial resettlement.

(5) Plans for the adaptation of Service rehabilitation centres for civilian purposes should be drawn up and put into operation as soon as possible.

(6) The question of the establishment of juvenile and industrial physical development centres should receive immediate consideration.

(7) Further provision for preventive as well as restorative treatment of psychological breakdown among industrial workers should be made.

(8) Steps should be taken to explore the possibility of making provision by village settlement or other appropriate means for workers with silicosis and pneumokoniosis.

(9) Every effort should be made to retain the services of those men and women doctors and physical training experts who have been conducting rehabilitation work in the Services.

YOUNG PERSONS IN INDUSTRY

(1) (i) The introduction of county colleges should not be unduly delayed. Young employees should attend these colleges for the equivalent of one day a week and physical education should be a compulsory part of the curriculum.

(ii) Whilst such training would make a valuable contribution to the maintenance of health, it cannot in itself be considered as sufficient and should be supplemented by the physical recreation which employers should provide for all young persons in industry.

(iii) These colleges should form a focal point for recreational and other activities in the evenings and should, therefore, be liberally staffed as an attendance of 200 per day might well cause a demand for recreational facilities for 1000 young people.

(2) Specialists in physical recreation should be employed by industrial firms with a view to conducting training which will develop agility and help to decrease the number of accidents.

(3) In the interests of the health of young workers the factory law relating to the hours of employment should be strictly enforced.

(4) An increased number of medical officers should be employed by industrial firms.

(5) Research should be undertaken with regard to the type of employment and its effect on the general health of the employee.

(6) Remedial classes designed to check and correct minor defects should be developed in industry.

(7) Serious consideration should be given to the possibility of adapting the present Service physical development centres for civilian use.

(8) Conditions of entry to physical development centres should be such as to encourage young employees either to apply for entry to the centres or to feel reconciled to direction to them by industrial medical officers.

(9) Liaison should be established between school authorities (including school doctors and organizers and teachers of physical education), industrial medical officers, parents, employers and the boys and girls themselves, with the object of ensuring better vocational guidance for school 'leavers.'

(10) There should be especial co-operation between the school medical officer, the medical and welfare officers of the works to which the young employee goes, and the physical educationist concerned to ensure that work within the young employee's capabilities may be chosen and provision made for any physical or other idiosyncrasy.

(11) There should be closer liaison between industry, youth service and the voluntary organizations.

WOMEN IN INDUSTRY

(1) Further investigation into the work of women in industry and its effect on their health should be investigated.

(2) Better facilities for rest, relaxation and physical recreation for women and girls should be introduced into factories; special training in corrective and compensatory exercises on the lines already initiated by the Central Council of Physical Recreation should be made more readily available.

REVIEWS

HAEMOGLOBIN LEVELS IN GREAT BRITAIN IN 1943 (WITH OBSERVATIONS UPON SERUM PROTEIN LEVELS)

Medical Research Council, Special Report Series, No. 252

(H.M. Stationery Office, London. 1945. Pp. 128. 5*s*.)

To those who have to undertake mass surveys involving blood examinations this report from the Medical Research Council is very welcome. It gives a standard value for haemoglobins estimated by the standard Haldane-Gowers method for men, women, pregnant women and children. It thus produces a control against which any investigation for abnormal blood changes can be compared. A similar investigation into red and white blood cells and differential counts would give a further contribution of the greatest value which this Committee could make. Any person who happens to work near a toxic substance, such as benzene, is immediately accused of being poisoned if they have a leucopenia, yet there is no information available as to how common leucopenia is in the general population.

Besides giving the valuable standard, the investigation shows that in the fourth year of war there is little anaemia in the general population. This, it implies without any good evidence, is due to the high iron content of the national loaf. The mean haemoglobin level for men was 102 per cent., there is a tendency to fall after the age of 50, but there is no great difference between the level for married and single men, and between those that do and do not feed in industrial canteens. In women, the haemoglobin is usually about 10 per cent. less than in men; the value tends to fall below the age of 50 and rise again afterwards. The reading was 2 per cent. lower in single than in married women, but there is no significant difference between married women with no pregnancies and single women. In children, the general picture is a rise from 1 up to 7, followed by a plateau of little change till 10, and then a steady rise to a maximum at 16. In London war-time day-nurseries, the incidence of anaemia in children between 2 and 5 was unduly high.

When the larger occupational groups were studied, the lowest figures were found in textile workers and locomotive and carriage workers, while the highest figures were in men in the police and Civil Service, while among women the figures were highest for housewives, the Civil Service and the W.A.A.F. The figure for the W.A.A.F. rose from 94·8 per cent. on entry to 103·1 per cent. after six months' service. It would be well for hospitals to note carefully that the figures for their employees are low on the list: 1081 nurses gave a mean of 92 per cent., while non-medical single male hospital workers gave a mean of 98·9 per cent. That the figure for nurses should be low is of the greatest importance. They are a very hard-working group of people who are very essential to the community. They live in hospitals where the supervision and understanding of diet should be the best and where blood counts can readily be obtained. These observations therefore reflect badly on our hospitals.

Serum protein estimations were made on an unselected group of 353 potential blood donors and the range of values was found to be unexpectedly wide: 5·56–7·65 g. per 100 ml. The mean of this group was lower than in 100 Canadian soldiers serving in this country, namely 6·56 compared with 6·78. The serum protein level of the donors was probably sub-optimal, and may be related to differences in consumption of animal protein between the two groups.

K. M. A. P.

HEALTH AND SOCIAL WELFARE, 1945–46

Advisory Editor, Lord Horder, G.C.V.O., M.D., F.R.C.P.

(Todd Publishing Co., Ltd., London. 1945. Pp. 519. 21*s*.)

This is a reference book about departments, committees and people concerned with health and social welfare; and there is undoubtedly great need for such a volume. It is divided into eleven sections, the first of 193 pages consisting of short reviews of subjects which have been topical during the past year. Of particular interest to the industrial medical officer are those on ' Rehabilitation and Resettlement ' by Anne Carr, ' Care of the Eyes in Home and Factory ' by Ida Mann, ' Compensation for Industrial Injury ' by Hermann Levy, and ' Medical and Nursing Services in Factories ' by A. I. G. McLaughlin. The last of these articles gets into a short space a very complete account of existing facilities in industrial medicine. There are also interesting articles on the medical services in the Dominions. Section 2 deals with Health Legislation and Policy, and Section 3 consists of official directories of the Government Departments concerned with health, both here and in the Dominions and Colonies. Section 4 contains official statements by these bodies, while Section 5 contains unofficial statements from non-Government bodies. Here it is interesting to learn that The Royal College of Physicians is drawing up a list of consultants and specialists in this country. Section 6—a very useful section—lists the composition of officially appointed committees; Section 7 discusses careers in Health and Social Welfare; Section 8 is a directory of organizations interested in these matters; Section 9 is concerned with statistics and tables; Section 10 lists books, periodicals and films; and lastly, Section 11 is entitled ' Who's Who in Health and Social Welfare.' Naturally the value of such a volume depends on its completeness and accuracy; and, unfortunately, it is on these rocks that it is wrecked. It is, for instance, extraordinary that *The Lancet* should be omitted from the list of medical periodicals, yet its editor is included in ' Who's Who,' whereas the *British Medical Journal* is listed and its editor omitted. It is difficult to understand why D.S.I.R. and M.R.C. are not discussed in the same way, while the A.R.C. is omitted completely. Nevertheless, there is a wealth of information assembled, which is not readily available elsewhere. It is, therefore, to be hoped that the book will meet with such success as will enable it next year to have sufficient man-power to make it both complete and accurate. It will then become a standard reference book for both health and social workers.

K. M. A. P.

ABSTRACTS

Annual Report of the Chief Inspector of Factories for the year 1944 (1945). Comd. 6698. H.M.S.O. London. Pp. 101. 1*s.* 6*d.*

This report is divided into four sections: general, industrial health, industrial advisory committees, canteens. Statistics concerning administration of the Factory Acts (1933–44), accident statistics for 1944, and lists of members of committees advising the Factory Department and the Ministry of Labour, are given as appendices.

General Report

Accidents. The decrease in accidents noted in the 1943 report has been continued—18 per cent. in fatal accidents, and 9 per cent. in non-fatal. The chief cause was probably the decrease in total man-hours of exposure to risk, but relief from strain and monotony helped, as did increased skill and experience of workers. Reportable accidents 1938–44 are given in the table. Scientific

REPORTABLE ACCIDENTS

Year	Fatal accidents	Variation on previous year (per cent.)	Non-fatal accidents	Variation on previous year (per cent.)
1938	944	—	179,159	—
1939	1104	+17	192,371	+7
1940	1372	+24	230,607	+20
1941	1646	+20	269,652	+17
1942	1363	−17	313,267	+16
1943	1220	−10·5	309,924	−1·1
1944	1003	−17·8	281,578	−9·1

study of variations in the total number of accidents reported from year to year cannot be made without accurate statistics of the numbers and composition of the labour force and the number of man-hours worked. The Statistics Department of the Ministry of Labour has therefore supplied the following estimates:

ESTIMATED NUMBER OF PERSONS EMPLOYED IN WORKS SUBJECT TO THE FACTORIES ACT, FOR THE YEARS, 1938–44.

Year	Males		Females	
	18 years and over	Under 18 years	18 years and over	Under 18 years
1938	3,130,000	490,000	1,430,000	540,000
1939	3,420,000	480,000	1,590,000	520,000
1940	3,410,000	500,000	1,830,000	530,000
1941	3,480,000	490,000	2,080,000	510,000
1942	3,500,000	480,000	2,500,000	480,000
1943	3,460,000	470,000	2,610,000	460,000
1944	3,360,000	440,000	2,500,000	420,000

Facts are given regarding accidents to women and young persons. In 1944 there was a decrease of 12 per cent. over 1943 in accidents to women; hair entanglement injuries still occur, but have decreased by 22 per cent. over the same period. Male young persons, however, have a higher accident rate than men, but the severity rate is less. There is growing interest in training schemes for juveniles entering factories, and the Ministry of Education collaborate in this vital matter.

Safety boots (with a toe-cap of high-grade spring steel built into an ordinary working boot, and standardized by the B.S.I.) have not been in adequate supply during war years, but increasing quantities are becoming available.

Information Branch. An Information service (in the Ministry of Labour) was set up in October 1943 to meet modern demands for technical knowledge on chemical, physical and mechanical processes which threaten the human side of industry. This service is to assist the Factory Department in its work, and include research into current literature; it also keeps in touch with other Government departments, and scientific libraries and information bureaux both in this country and abroad. Sir Wilfred Garrett, H.M. Chief Inspector of Factories and writer of the report, says that this Information service ' will more and more become a focus of two-way traffic with all concerned with safety, health and welfare in factories.'

Hours of Employment. Reports from all parts of the country show a decided reduction in the hours of actual work of both women and young persons. Details are as follows:

AVERAGE WEEKLY HOURS WORKED

Date	Men (21 years and over)	Youths and boys	Women (18 years and over)	Girls	All workers
Oct. 1938	47·7	46·2	43·5	44·6	46·5
July 1943	52·9	48·0	45·9	45·1	50·0
Jan. 1944	52·0	47·1	45·2	44·6	49·2
July 1944	51·2	46·7	44·6	44·2	48·6

Apparent causes for reduction trends are: recognition by firms that long hours do not result in increased production; less opposition to shorter hours by workers and trade unions; reduction of night work and overtime, and free week-ends, have made workers appreciate the value of free time; the pay-as-you-earn scheme may help to make workers accept shorter hours; the fuel economy campaign has had its influence.

(There are further sections on heating, ventilation, washing and clothing accommodation, lighting, blackout, colour in factories, seating, personnel management and welfare supervision, the Industrial Museum and staff.)

Industrial Health

This section of the report (32 pages) is presented by Dr. E. R. A. Merewether, the senior Medical Inspector of Factories. Interest in industrial health problems grows and some examples are given: the recent report of the Royal College of Physicians of London (see this JOURNAL, January 1945, p. 51) is referred to as an index of increasing interest; the Universities of Manchester, Durham and Glasgow have opened Departments of Industrial Health; fellowships in the subject have been given by the Nuffield Foundation; the Society of Apothecaries has instituted a Diploma in Industrial Health; the M.R.C. has set up a research unit at Cardiff to investigate pneumokoniosis; the Royal College of Nursing carries on training for industrial nurses; postgraduate courses of instruction in the subject become

available in London and the provincial Universities; the St. John Ambulance Association, the British Red Cross Society and the St. Andrew's Ambulance Association are collaborating to raise the standard of first aid in industry. A special book of industrial first aid is to be published.

Radiological and Ophthalmological Panels (names given in an appendix) have been constituted, in addition to the Dermatitis Panel already set up, and some account of their work is given in general terms. These panels are to advise the Factory Department, in the same way that the Information branch serves the Ministry.

Industrial Diseases. Particulars of the cases of industrial poisoning or disease notifiable under Section 66 of the Factories Act, 1937, and under Section 3 of the Lead Paint Act, allowing comparison with previous years, are given below:

DEATHS FROM FIBROSIS OF THE LUNG, INCLUDING SILICOSIS, ASBESTOSIS, PNEUMOKONIOSIS, AND BYSSINOSIS (ENGLAND AND WALES) 1939–1944 †

	1939	1940	1941	1942	1943	1944
Silicosis	439	522	406	417	470	445
Asbestosis ..	18	11	17	11	8	10
Pneumokoniosis	—	—	—	—	—	37
Byssinosis ..	—	—	—	6	7	1
Other cases of fibrosis ..	584	650	461	443	493	531
Total ..	1041	1183	884	877	978	1024

Dermatitis. The number of cases notified voluntarily was 8180 as compared with 8926 in 1943, and 8802 in 1942. The proportion of cases due to oil has increased.

Radio-active Substance and X-rays. The number of factories engaged in luminizing, and the number of persons employed as luminizers is given below:

	1940	1941	1942	1943	1944
Factories	41	52	59	72	69
Luminizers	309	391	378	411	561
Luminizers with more than 1 year's experience	112	205	220	274	343

On the whole the health of luminizers is good. This is attributed to the more widespread use of the Mayneord protective paint chamber, and to legislation. There have been no cases of aplastic anaemia. Slight leucopenia was found in 18 cases (less than 4 per cent.). Relative lymphocytosis with a normal white cell count was present in 95 cases (21·1 per cent.); leucocytosis in 9 cases (2 per cent.); and in 51 cases (11·3 per cent.) abnormal cells of the myeloid series were found. Only 8 per cent. of workers showed a red count below 4½ million, and Hb below 84 per cent.

Young Persons. The number of Examining (or Appointed) Surgeons in 1944 was 1862. They carried out 231,546 statutory examinations of young persons (14–16); 3066 of these were re-examined; 3578 were rejected (0·8 per cent. of the boys and 2·3 per cent. of the girls), largely because of pediculosis. Errors of refraction account for 568, diseases of the skin for 450, circulatory system 201, lungs 111.

Canteens

Canteens have now appeared for the most part to have settled down as part of the general welfare services

CASES OF INDUSTRIAL DISEASES REPORTED AS FROM 1900

Poisoning by	Reported cases *								
	1900	1910	1920	1930	1940	1941	1942	1943	1944
Lead	1058^{38}	505^{38}	289^{44}	265^{44}	108^{6}	59^{5}	72^{8}	46^{5}	41^{5}
Phosphorus	3	—	—	—	—	1	—	2	1
Mercury	9	10^{1}	5	3	5	5	1	4	7
Arsenic	22^{3}	7	3	1	2^{2}	—	6	2^{1}	3
Manganese	—	—	—	—	—	—	—	1	1
Carbon bisulphide	—	—	—	—	1	1	—	—	1
Aniline	—	—	—	24	64	249	204	79	55
Benzene (chronic)	—	—	—	—	3^{2}	1^{1}	1^{1}	1^{1}	1^{1}
Toxic jaundice	—	—	6	—	20^{4}	44^{13}	27^{6}	16^{4}	12^{1}
Toxic anaemia	—	—	—	—	—	—	14^{3}	7^{1}	12^{6}
Compressed air	—	—	—	—	3^{1}	—	—	1	1^{1}
Anthrax	37^{7}	51^{9}	48^{11}	43^{6}	37^{5}	22^{3}	25^{1}	17^{4}	8^{3}
Epitheliomatous ulceration	—	—	45^{1}	194^{36}	166^{15}	128^{11}	113^{8}	160^{15}	205^{20}
Chrome ulceration	—	—	126	95	121	103	89	226	121

The reported cases of gassing for the year 1940–44 are given below: *

	1940	1941	1942	1943	1944
Carbon monoxide ..	162^{20}	238^{24}	249^{11}	232^{17}	209^{21}
Carbon dioxide ..	4^{1}	9^{2}	3	—	1
Sulphuretted hydrogen	9^{3}	17^{1}	9^{3}	12	7
Sulphur dioxide ..	15	16	22	28	9
Chlorine	39	43	52^{1}	58^{1}	59
Nitrous fumes ..	236^{2}	217^{1}	220^{2}	135^{4}	55^{1}
Ammonia	4	13^{2}	6	9	8^{2}
Benzol	4^{1}	7^{3}	10^{4}	1^{1}	1
Benzine and petrol ..	2	10^{2}	2^{1}	2^{1}	2
Naphtha	—	1	—	—	2
Trichlorethylene ..	14^{1}	29^{2}	18	87^{3}	16^{1}
Nickel carbonyl ..	17	6	37	30	37
Phosgene	3^{1}	46	9	9	3
Hydrochloric acid ..	—	1	4	2	3
Hydrocyanic acid ..	—	2	1	—	1
Bitumen, creosote, tar, oil	—	2	—	2	1
Other	76^{2}	115^{4}	134^{3}	89	36
Total	585^{31}	782^{41}	776^{25}	695^{27}	450^{25}

Pneumokoniosis. Deaths attributed to silicosis and asbestosis, with or without tuberculosis, occurring in factories have been investigated. Later, analysis of these cases will be made. The following table gives the deaths from lung fibrosis 1939–44.

* Raised figures indicate deaths.

† These figures are supplied through the courtesy of the Registrar-General and comprise the cases (other than school children) in which any of the above designations were entered on the death certificate as the primary cause of death. Many of these cases are non-occupational, but may give clues to research.

of factories employing more than 250 persons, and of many smaller firms. The increase in canteens can be seen below:

	Dec. 1943	Dec. 1944
Factories employing over 250	4873	5046
Factories employing under 250	5704	6584
Docks	176	179
Building sites	782	245

At 2573 canteens of all sizes the percentage of persons employed who took a main meal was as follows :

Size of factory	Day shift (per cent.)	Night shift (per cent.)
(*a*) More than 1000 employed	28·9	35·8
(*b*) 500–1000 employed ..	26·8	47·5
(*c*) 250–500	39·8	50·2
(*d*) Under 250 employed ..	46·0	54·8

From reports of the Ministry's Factory Canteen Advisers it appears that the smaller the factory the larger the percentage of workers employed who take hot or main meals in the canteen.

The general standard of cooking is slowly rising. There is more interest in menu planning. Particular improvement is noted in the methods of cooking vegetables. There is a growing demand for meals of the snack variety at the main meal break, and a number of canteens have gone over to the cafeteria system. Most firms favour the principle of giving special service to young persons, but this must be developed as the proper feeding of the young is a service of great importance to the community. Such a service must be accompanied by educative effort and accurate observation of results, and this is well within the competence of industry.

Study of Women on War Work in Four Factories. WYATT, S., assisted by MARRIOTT, R., DAWSON, W. M., DAVIS, NORAH M., HUGHES, D. E. R., and STOCK, F. G. L. (1945). *Industr. Hlth. Res. Bd. Rep.*, No. 88. H.M.S.O. Pp. 44. 9*d*.

The women now employed in industry vary considerably as regards home background, social status and previous experience, yet, judging from the sample included in this inquiry, they seem to have settled down to factory life remarkably well. On the whole, they were fairly satisfied with their jobs and with working conditions, and there were few general complaints. Worries and difficulties were usually local or individual and connected with specific factory conditions, and were less numerous and disturbing than those associated with home life. The attitude of the women to specific factors may be summarized as follows :—

Inside the factory

(*a*) Unsuitable atmospheric conditions, especially on the night shift, were a frequent cause of discomfort, and probably of reduced efficiency.

(*b*) Relations with other workers were very satisfactory, but contacts with supervisors, and still more with shop managers, were often remote or non-existent, and were unlikely to promote complete unity of aim and effort.

(*c*) A large majority (77·6 per cent.) of the women were satisfied with the amount of payment, and a somewhat smaller proportion (62·1 per cent.) with piece-work prices.

(*d*) The attitude to the pace of work was highly satisfactory, since only 8·8 per cent. of the women were dissatisfied and most of these were employed in two factories.

(*e*) Approximately 50 per cent. of the women were employed on the three-shift system with a weekly change of shifts, and a large majority appeared to be content with this arrangement. Of the three shifts, the morning shift was by far the most popular, and the night shift the least. As a rule, the women preferred to begin the day in the factory, and to have the later part of the day free.

(*f*) About one-third of the women rather liked night work, mainly because of the comparative absence of distracting and disturbing influences, and the chance to do things in daylight.

About 40 per cent. of the women on night work had not more than six hours in bed, and some not more than four hours. Married women, on the average, had a shorter rest than single women. A large majority of the women on night work usually had a snack rather than a full canteen meal. There was some evidence that night work was associated with loss of appetite and digestive trouble.

(*g*) Satisfaction with work was more widespread among women who were formerly employed in the factory or in the home, and among volunteers rather than conscripts. Older women tended to be more satisfied than younger women, and married women more so than single. Some women found the work monotonous and meaningless, and about two out of every five felt they were contributing little or nothing to the war effort.

Outside the factory

(*h*) The average time for the single journey between home and factory varied from 27 to 41 minutes in the different factory groups. A majority (60·8 per cent.) of the women were able to complete the journey in 30 minutes or less, and only 6·8 per cent. took more than one hour. On the whole, the transport services were well organized, and there were few complaints.

(*i*) Only a moderate proportion (52·6 per cent.) of the women were satisfied with the time available for recreation, and the proportion was less for married than for single women. Some women had enough time, but not enough energy or inclination, to enjoy their leisure. The main preventive factors were long or unsuitable hours of work, and household duties.

(*j*) Only two-thirds of the married women lived in their own homes; most of the remainder, and approximately two-thirds of the single women, lived with parents. Less than half the married women had children living at home, and very few had children under five years old.

Although only a minority of the women seemed to be overburdened with the practical domestic problems of housework, shopping and the care of children, a larger number complained of home difficulties and appeared to be worried and unhappy in their home life.

(*k*) About 59 per cent. of the women claimed to have had good health before entering the factory, and a somewhat smaller proportion (46 per cent.) alleged that health had been impaired by factory work. Younger married women and older single women had the poorest health histories.

Approximately 50 per cent. of the women had worries and anxieties, mainly connected with men-folk overseas, health matters and home affairs.

(*l*) Sickness absence was more prevalent among married women (especially those under 35) than among single women. It was also associated with home duties and difficulties, lack of daytime sleep when on the night shift and personal worries. Those with most sickness absence also felt more fatigued, both during and after work, and were more inclined to blame factory conditions for their ill-health.

In general, the women in these factory groups seemed to be content if the wages and comfort reached reasonable standards, if hours of work were not too long and if they were not moved from their usual jobs. Not more than 2 per cent. were seriously dissatisfied with their jobs and with everything connected with them, from 10 to 15 per cent. were moderately dissatisfied and most of the remainder were content. Few women complained unless they were jolted by some unwonted circumstance from their accustomed grooves or were overwhelmed by home duties and worries.

Resettlement of the Disabled. PATTERSON, J. W. T. (1945). *Lancet*, **2**, 766.

During the final stage of readjustment to the factory tempo, disabled men are apt to be restless and feel out of sorts. A scheme of 'graduated final resettlement training' should therefore be drawn up. Such a programme might include working half-time for a period. For new entrants, visits to different departments in the factory could be arranged and opportunities given for education in working hours.

Assessment of capacity for work is important. Army assessment (the Pulhems system) was based on seven qualities:

(1) Physique, or general constitution;
(2) Arm, or upper-limb efficiency;
(3) Locomotion, or lower-limb efficiency;
(4) Hearing; (5) Vision;
(6) Mental capacity; (7) Emotional stability.

Ideally, every civilian employment should be examined in relation to these qualities. Thus a job-formula could be expressed.

Industrial Hygiene in 1944. TABERSHAW, I. R., and BOWDITCH, M. (1944). *New Engl. J. Med.*, **231,** 706.

Progress and development of industrial hygiene have been profoundly influenced by the war. A major problem is to find a proper place for the handicapped worker. A medical preplacement examination in which the physician will not only evaluate the worker's disability, but will also be aware of the implications of the job for which the applicant may be fitted, is necessary. Classification of disabilities and job analysis codes have been worked out. Provision of adequate medical service to the small industrial plant is a problem of major importance. Hannon (*Trans. Canad. Inst. of Mining and Metallurgy*, 1944, **47,** 180) used powdered metallic aluminium and found that in a series of 143 men with silicosis and disability, 135 were improved, 2 made worse and 6 unimproved. In another group with positive x-ray findings but no disability, 93 out of 104 improved; 185 treated prophylactically developed no symptoms. Tripoli, which is 98 per cent. quartz, produces in experimental animals the typical proliferative silicotic reaction, but does not frequently produce human silicosis, since its physical properties prevent dust formation (McCord *et al.* (1943), *Industr. Med.*, **12,** 373). Metal fume fever has repeatedly been described in welders. A series of five cases of poisoning with one death resulted from welding cadmium-plated steel (Spolyar *et al.* (1944), *J. industr. Hyg.*, **26,** 232). Four to 8 hours after exposure irritation of the throat occurred, followed by cough and headache, and after 20–36 hours acute pulmonary oedema. Criteria for the diagnosis of occupational dermatoses have been established, and methods of control are adequate if properly applied. Lead borosilicates used for ceramics are potentially toxic. Letonoff and Kety (1943) (*J. Pharmacol. exper. Therap.*, **11,** 151) report satisfactory results of treating lead poisoning with sodium citrate. In cases of early poisoning with tetrachlorethane a mononucleosis has been observed (*Brit. med. J.*, 1943, **1,** 348; *Industr. Med.*, 1944, **13,** 230). The threat of deafness to workers in noisy occupations is stressed. Audiometer studies of workers before, during and after employment are indicated.

Mass Miniature Radiography of Factory Groups in Middlesex. POINTON DICK, W. (1945). *Brit. med. J.*, **2,** 568.

If the population of Middlesex be taken as 2 million, there are approximately 1·2 million in the 14–55 age group. So probably some 3000 undiagnosed cases are in need of treatment (half without symptoms) in this county. In 1944 some 34,227 workers were examined; of these 140 were known cases of pulmonary tuberculosis; 861 (2·5 per cent.) were discovered to have the disease but no further action was necessary (this included 537 healed primaries); 434 (1·3 per cent.) showed significant lesions. Of this last group 275 (63·4 per cent.) were unilateral; 159 (36·6 per cent.) were bilateral. This group was disposed as follows: 346 (1 per cent.) were kept under observation; 88 (0·3 per cent.) were put on to treatment. In the 88 treatment cases there was no sputum in 34; a negative sputum in 32; and a positive sputum in 22 cases only.

Nursing Records in Industry. FILLMORE, ANNA M. (1945). *Amer. J. publ. Hlth.*, **35,** 221.

This is a useful short discussion of the type of records that should be kept by nurses working in industry; equally unsatisfactory are records so complex that the workers are kept waiting while they are completed, and records so inadequate that no use can be made of them other than the protection of the firm in case of litigation. It is suggested that the following questions should be answered before the type of record system is decided upon: (1) What are the legal requirements? (2) For what purposes, other than legal, will the records be used? (3) What methods will be used to carry out these purposes? (4) How can we keep our records system simple enough for a varied group of nurses to understand and use without confusion? (5) What simple devices may be used to save time, improve accuracy and increase the use to which the records may be put? (6) How much can we expect the plant to spend on record forms, filing cabinets and other equipment? (7) How much clerical help will the nurse have? Each of these points is briefly discussed; under (2) are included suggestions (*a*) for improving the advice given to the individual, (*b*) for planning the health service for the factory and (*c*) for advising the management as to the state of the health of the workers. Among devices to save time are included a standard set of abbreviations for use in recording. Most of the clerical and statistical work of analysis can be done in a central office rather than in the surgery.

Inorganic Industrial Hazards. FAIRHALL, L. T. (1945). *Physiol. Rev.*, **25,** 182.

Our knowledge of the toxicity of many inorganic substances is scanty at best and industrial injury has often resulted from ignorance rather than negligence. The effects can usually be divided into acute and chronic—the one accidental poisoning by large doses, the other continual exposure to low concentrations.

Lead. Lead poisoning is so well known that it is soon recognized, the evidence has therefore greatly diminished. It has, however, recently been observed among workers using red lead in stencilling glass before cutting and grinding, for stencilling silk, among telephone and telegraph workers, in type setting, from cutting tobacco on lead plates in cigar manufacture, from lead dust in automobile body plants, in the manufacture of lead bronze bearings, among solderers, metal finishers and welders in automobile plants, from setting stained glass in lead, from the volatilization of lead from the painted metal in cutting structural steel with an oxy-acetylene flame, and among soldiers exposed to fumes from field kitchens in which leaded petrol was burned. The cardinal symptoms of lead poisoning are colic, the blue line, stippling of red cells, pronounced urinary excretion of lead, palsy and anaemia. Any or several of these may be absent. The absorption of lead from the lungs is related to the solubility of the lead compound, thus less lead phosphate would be absorbed than lead monoxide. The low incidence of poisoning in galena miners is due to the insolubility of lead sulphur. The anaemia of lead poisoning is probably wholly due to haemolysis. Porphyrinuria as a diagnostic sign in lead poisoning should be treated with some reserve.

Mercury. 32,855 workers were potentially exposed to mercury poisoning in the U.S.A. in 1940. Distinctive tremor, loss of teeth, foetid breath and salivation are peculiar symptoms. Mercury constantly gives off vapour. At 20° C. the concentration of air saturated with mercury vapour is 1·84 p.p.m. while at 40° C. it is 8·5 p.p.m. The normal urinary excretion of mercury is 0·1 to 1·0 mg. and this may rise to several milligrams in persons with amalgam dental fillings or who are in industrial contact with mercury.

Cadmium is used in electro-plating. In 1941, 268 cases of cadmium poisoning following ingestion were reported in the U.S.A., mostly the result of using cadmium-coated containers for food or drink. The symptoms include salivation, choking attacks, persistent vomiting, abdominal pain, diarrhoea and tenesmus. Most fatalities have resulted from the inhalation of cadmium oxide fume—the first symptoms are usually dryness of the throat, cough, headache, vomiting and a sense of constriction in the chest. Pneumonitis and broncho-pneumonia may result.

Manganese. The literature only reveals 353 cases of poisoning up to date. It occurs in general through the inhalation of fume. The early symptoms include langour and sleepiness which precede weakness in the legs. A stolid mask-like face develops and is followed by marked emotional disturbances and a spastic gait. It has been reported in electric welders using electrodes containing manganese.

Beryllium is used in alloys with copper and aluminium. It profoundly affects the mechanical properties of the metal, it becomes very fatigue resisting—thus springs retain their elasticity. Most evidence shows that disease in beryllium plants is due to the fluorides contained in the dust.

Molybdenum. Molybdenum steel is used in modern armour plate. No comprehensive study of possible toxic effects has been made, but pharmacological studies suggest that it is not particularly toxic.

Tungsten is used in making high-speed steels and electric-light and radio-tube filaments. Exposure in industries is chiefly in crushing and milling the ores—scheelite and wolframite. In warm-blooded animals tungsten causes death from respiratory paralysis.

Antimony and Arsenic. Arsenic is much the more toxic. Arsine has caused many human fatalities, but there is no fatality from stibine recorded. Arsenic causes vomiting, albuminuria, jaundice and haemolysis of the red cells. Arsenical dusts produce troublesome skin lesions and perforation of the nasal septum, while slow absorption is evidenced by bronzing and gastric symptoms. Antimonial poisoning is not an industrial disease of any consequence.

Indium is used in electro-plating cadmium, alloyed with silver it makes it tarnish proof. Few investigations regarding its toxicity have been carried out and no occupational ill-health has so far been reported.

Uranium. A wet process is used in extraction and therefore exposure here is not serious. It is employed in steel to measure hardners; in colouring glass a fluorescent canary yellow, as the black oxide for red and black in the ceramic industry. It is used as a catalyst. Uranium oxide has a new and important industrial application in connection with elimination of the effect of current singes in powerful projection lamps. Uranium and its salts are highly toxic. Chronic nephritis has repeatedly been reported, and hepatic degeneration also occurs. Since uranium is a radio-active element it can be detected by means of a sensitive Geiger-Müller counter in amounts as small as 10^{-12} gm.

Magnesium and Zirconium. The former is important as a light alloy, while the latter is an important constituent of tracer bullets, etc. Magnesium introduced in the form of splinters reacts with local tissue with the evolution of gas, resulting in gas tumour and necrosis. Neither metal is toxic in the ordinary sense.

Selenium is used in the glass and ceramic industry. Pallor, gastro-intestinal disturbances, garlicky breath and nervousness are reported symptoms. A concentration of hydrogen selenide of 0·005 mg./litre produces intolerable eye and nasal irritation.

Tellurium is increasingly used for hardening and toughening metals.

Fluorine. Interest has increased because of the great expansion of aluminium and magnesium production since the war and the increased use of cryolite sprays in orchards to prevent the ravages of the cooling moth. Interest has been drawn to the relation of fluorine in domestic water to mottling of the teeth and dental caries. Finally, enormous quantities of hydrofluoric acid are now demanded by the petroleum industry as a catalyst. Exposure to fluoride fumes in toxic concentrations causes chills, followed by shortness of breath, cough with scanty secretion, dyspnoea and elevated temperature. Cyanosis follows. There is a leucocytosis and raised blood sedimentation rate. The process lasts up to 2 months. Exposure of workers to cryolite dust causes severe bone changes but no evidence has so far been reported showing that osteosclerosis results from exposure to hydrofluoric acid.

Chromium and Vanadium. Hexavalent chromium derivatives are toxic, trivalent are inert. Chrome plating baths give rise to dermatitis, chrome ulcers and perforation of the nasal septum. A new source of chromate exposure is spray painting. Vanadium compounds are acutely irritant. The characteristic effect is a chronic bronchitis which may result in specific infectious complications.

Silica. Silicosis is one of the oldest of occupational diseases; it results from the inhalation of dust containing free silica. It is characterized by generalized fibrotic changes and miliary nodulation in the lungs. Chemical signs are shortness of breath, a lowered vital capacity, a lowered capacity for work, increased susceptibility to tuberculosis, and a characteristic x-ray appearance of the lungs.

Control of Occupational Tuberculosis in Hospitals. BRADY, L. (1945). *J. industr. Hyg.*, **27,** 234.

Student nurses often acquire tuberculosis infection as a result of exposure in the course of their training in hospitals, so for them tuberculosis is an occupational disease. Physicians, graduate nurses, orderlies, clerks and others who have contact with patients are all subject to the hazard in varying degree, and the frequency of occupational tuberculosis among these attendants can be reduced to a minimum by adopting methods of prevention and control. A hospital is duty bound to prevent occupational diseases among its employees as much as any other employer, and many States of the U.S.A. require the employing hospital to provide medical care and compensation for occupational tuberculosis. Administrators of hospitals must, in addition, control tuberculosis among their employees because they may infect the patients. Hence every attendant should have a routine chest x-ray before permitting him to have any contact with patients, and periodically thereafter. The x-ray demonstrates the earliest stages of the disease for a period of months during which the patient may have no symptoms or physical signs, but nevertheless has communicable tuberculosis. Tuberculin testing, employed in addition to x-ray examinations, aids in control. The cost of the routine measures advised may, in a few years, be balanced by the saving effected by the reduction in the incidence and severity of tuberculosis cases.

The American Trudeau Society has surveyed the policies of the hospitals in the U.S.A. which have training schools for nurses. Of the 1284 schools questioned, 73 per cent. replied. Pre-employment x-rays were used on student nurses by 85 per cent. of the hospitals, and the tuberculin test by 68 per cent. of them, but of the graduate nurses and resident staff only about a third as many were examined.

The Microdetermination of Stibine. WEBSTER, S. H., and FAIRHALL, L. T. (1945). *J. industr. Hyg.*, **27,** 183.

The authors describe a new method for the quantitative evaluation of small amounts of stibine (antimony hydride) in the air. The concentration range extended from 200 p.p.m. down to 1 or 2 p.p.m. A number of methods, described by other investigators, are discussed at some length by the authors, and some of them have been extended by them in various ways. The analytical procedure finally adopted is complicated, and as stated here it omits some of the details. A suitable volume (e.g. 100 ml.) of the gas mixture is passed through a bubbler tube containing 20 ml. of 6 per cent. mercuric chloride solution. The liquid is then mixed in a stoppered glass cylinder with 6N hydrochloric acid up to a total volume of 30 ml. After the addition of 0·5 ml. of 0·1N ceric sulphate solution (for oxidizing the antimony salt) air is blown in so as to remove the free chlorine, and 3 drops of 1 per cent. hydroxylamine hydrochloride are added to remove excess of ceric sulphate. Then 1·0 ml. of 0·2 per cent. rhodamine B is added so as to form rhodamine B antimony complex, and this coloured product is extracted with benzene. Its density is determined by means of a spectrophotometer, and the reading is converted into micrograms of antimony by means of a standardized graph. By the method described single samples of stibine can be analysed in 15 minutes. The presence of other toxic hydrides likely to be found as impurities does not interfere with the procedure.

Fluorescent Mineral Dusts as Tracers for the Localization of Particles in Tissue. YAGODA, H., and DONAHUE, D. D. (1945). *J. industr. Hyg.*, **27**, 193.

The localization and identification of dust particles in exposed lung tissue is difficult when the usual methods of optical microscopy are employed, as the minute grains possess but little distinctive coloration or optical relief. Many minerals whose dust is of toxicological interest fluoresce in ultra-violet light, and it was thought that this property could be utilized in tracing the deposition of dust particles. The fluorescent minerals are chemically and physically identical with the more abundant non-fluorescent varieties encountered in mining and industry, except that they contain a trace of fluorescent constituent. Willemite, a zinc silicate from Franklin, N.J., which has an intense green fluorescence, was selected for experiment, and after powdering the dust particles were insufflated into the lungs of a rabbit. On subsequent examination in ultra-violet light they were found to be adhering as a continuous film to the lung surface exposed by incision. The tissue was fixed and embedded in paraffin, and when sections 15 microns thick were examined under oblique ultra-violet light impinging directly on their surface, numerous fluorescing particles were seen within the bronchi and alveoli. After staining with eosin and methylene blue, and also on ashing the sections by heating the slides to 400° C. the fluorescence persisted.

In a second experiment a suspension of finely ground hyalite (a hydrated variety of amorphous free silica that fluoresces green) in normal saline was injected subcutaneously into a rabbit. Paraffin sections, made 30 days later, showed under ultra-violet light the presence and distribution of the fluorescing foreign dust bodies, so the fluorescent properties of the tracer were not altered by the prolonged action of the tissue fluids. Other observations were made on animals exposed for several months to the dust of scheelite, a tungsten ore. The particles were chiefly located in dense deposits of small foci within thickened interalveolar septa, and in lesser amounts uniformly distributed throughout the remainder of the lung. Fine particles down to about 0·5 micron could be discerned readily by their characteristic fluorescence.

The Potency of Silica Particles of Different Size. TEBBENS, B. D., SCHULZ, R. Z., and DRINKER, P. (1945). *J. industr. Hyg.*, **27**, 199.

It is generally admitted that the potency of silicosis-producing dust increases inversely with the particle size. In order to get further evidence the authors separated ground flint into four fractions, with particles averaging 3·3, 1·7, 1·0 and 0·6 microns, and they injected 400 mg. of the dust in saline suspension into the ear vein of rabbits in two equal doses at three-month intervals. Nine rabbits were used for each size group, and one of each group was subsequently killed at three-months intervals. At the end of 18 months the livers of the rabbits receiving 0·6 and 1·0 micron particles were almost wholly replaced by gristly white fibrous tissue, whilst those of the rabbits receiving 1·7 micron particles showed only a moderate amount of scarring, and the livers of the animals receiving the 3·3 micron dust showed only slight enlargement, and pitting. The other organs gave evidence of a separation of particles according to their size, the finer particles (1·0 micron or less) being found in lungs, spleen and bone marrow as well as liver. The 1·7 micron particles were found chiefly in liver and lungs, whilst the 3·3 micron particles were confined to the liver and lungs. It follows that particles of 1·0 micron and under are the most dangerous, not only in their ability to remain suspended in the air, but still more because of their activity once they gain entrance to the body tissues.

The Concentration of Arsenic in Tobacco Smoke determined by a Rapid Titrimetric Method. THOMAS, M. D., and COLLIER, T. R. (1945). *J. industr. Hyg.*, **27**, 201.

Commercially prepared tobacco contains from 3 to 50 p.p.m. of arsenic, reckoned as arsenious oxide, and natural unfermented tobacco about ten times as much. When tobacco and cigars are smoked part of this arsenic is volatilized and inhaled, and part remains behind in the butts and ash. In order to estimate its amount an apparatus was employed which estimated actual smoking conditions, a stream of air being sucked at definite intervals through the ignited tobacco. The arsenic was analysed by a modified Cassil-Wichmann method, which depends on the titration of mercuric arsenide. Series of experiments, made in 1942 and 1945, gave fairly concordant results, and it was found that on an average the unpuffed smoke of cigarettes contained 2 p.p.m. of arsenic; the puffed smoke, 5–7 p.p.m.; the ash, 23–32 p.p.m.; and the butts, 7–18 p.p.m. In the experiments with cigars the unpuffed smoke contained 0·8 p.p.m.; the puffed smoke, 1·4 p.p.m.; the ash, 12·2 p.p.m.; and the butts, 5·4 p.p.m. Pipe tobacco, when smoked in a clay pipe, showed an average of 1 p.p.m. in the unpuffed smoke, 7 p.p.m. in the puffed smoke and 26 p.p.m. in the ash. Taking the results as a whole, the smoke contained 11–23 per cent. of the total arsenic, whilst the concentration, in milligrammes of As_2O_3 per cubic metre, was 0·2 –3·0 with cigars, 1·7–5·7 with pipe tobacco and 3·3–10·5 with cigarettes.

Evaluation of Urinary Lead Determinations. I. The Significance of the Specific Gravity. LEVINE, L., and FAHY, J. P. (1945). *J. industr. Hyg.*, **27**, 217.

The determination of urinary lead is an important procedure in the control of industrial exposures to the metal. Though 24-hour samples are more reliable than spot samples, they are practically impossible to obtain, but it is easy to take spot samples and record the results in terms of weight by volume concentration. Previous investigators have shown that the measurement of urinary lead gives a true picture of the lead hazard in the majority of industrial processes. The present investigators have analysed 1157 samples of urine in cases where there was greater or less exposure to lead. In addition to their lead content the specific gravity was determined, and was named *G* (e.g. a sp. gr. of 1·026 represented a *G* of 26). The samples were split into seven classes of about 150 samples each, according to their *G*, and the averages showed that as the *G* rose from 12·5 to 32·7 the lead content rose in fair proportion from 9·4 microgrammes per 100 ml. to 19·9 microgrammes, the correlation coefficient being +0·94. On correcting the urinary lead concentrations of the seven classes to the mean *G* of all the samples, the coefficient of variability of the corrected values fell to 6·4 per cent. as compared with 22·4 per cent. for the uncorrected values. These data therefore show that when the lead excretion is calculated on the basis of total solids the result is more representative of true exposure than when calculated on the basis of urine volume. Calculated in this manner the data seem to show that spot samples are not less representative than 24-hour samples.

OBITUARY

WILLIAM DAVID JENKINS, B.A., M.R.C.S., L.R.C.P., J.P.

Industrial medicine has lost one of its most distinguished pioneers with the passing of Dr. W. D. JENKINS, chief medical officer to the South Metropolitan Gas Company. He was a student of the Middlesex Hospital, and before studying medicine took a B.A. degree with honours in the University of Wales. At the outbreak of the war of 1914–18 he volunteered as a combatant and was commissioned in the Royal Artillery, and saw active service until he was invalided home in December, 1917. He then returned to his medical studies and qualified as M.R.C.S., L.R.C.P. in 1921. Subsequent to this he practised in South Wales and was commissioned as a Justice of the Peace in the County of Glamorgan.

Dr. Jenkins was one of the founder members of the Association of Industrial Medical Officers, and gave good service as a member of the executive committee. He joined the South Metropolitan Gas Company in 1932, and with the company's close support introduced a medical service of the highest order. He studied the occupational hazards of the gas industry with an enthusiasm which was most infectious, and became a leading authority on the causation, prevention and treatment of pitch and tar cancer. His contributions to medical knowledge were made more by the spoken than by the written word. A few weeks before his death he arranged with the collaboration of his company a practical demonstration of the industrial problems in this field for the advisory panel on dermatological problems in industry to the Minister of Labour and National Service. He was a Freeman of the City of London, and was intimately connected with the work of the St. John Ambulance Brigade in London. At the time of his death he was surgeon to the Brigade in the County of London. He was a prominent member of the Savage Club. Dr. Jenkins was a man of outstanding personality, of great courage and charm, and possessed an aptitude for the clear expression of his opinions. With all this, and his specialized knowledge in the field of industrial health, he will be remembered by all who worked with him, whether as a worker, employer or as a medical colleague, until they too pass on, as a man of great humanity, honesty and unselfishness, and we his friends for many years will feel the loss of his impartial counsel and courageous presence.

A. J. A.
E. R. A. M.

PROCEEDINGS OF THE ASSOCIATION OF INDUSTRIAL MEDICAL OFFICERS

FORTY-FIRST MEETING

The forty-first meeting of the Association was held on Friday, December 14, 1945, at the London School of Hygiene, Dr. W. Blood in the chair.

Before the business commenced, at the request of the chairman members stood in silent tribute to the memory of Dr. W. D. Jenkins, one of the original members of the Association, who died in London on November 10, 1945.

Following the private business, papers were read as follows: 'The medical officer and accident prevention,' by Dr. J. A. A. Mekelburg (London); 'Silicosis in the haematite iron ore industry in West Cumberland,' by Dr. J. Craw (Whitehaven); 'Strikes,' by Dr. T. A. Lloyd Davies (Nottingham); 'Some observations on analysis of certified sick absence,' by Dr. J. Tarsh (Liverpool).

On Saturday morning, December 15, the meeting was continued at St. Mary's Hospital, Paddington, where Sir Alexander Fleming, F.R.S., addressed the Association on the discovery and preparation of penicillin. Dr. M. Y. Young described its use in common industrial conditions. Mr. Dickson Wright spoke on the surgical application of penicillin and demonstrated various pharmaceutical preparations.

Honorary Membership

Sir Henry Bashford, one of the original (founder) members of the Association, was elected an Honorary Member on his retirement from the post of Treasury Medical Adviser.

Circulation of Minutes

Dr. W. Gunn (London) suggested that the minutes of each meeting should be circulated to members. He pointed out that many members were unable to attend meetings and would like to be kept in touch with the proceedings of the Association. The matter was referred to the Executive Committee for further report.

Institute of Ophthalmology

Dr. H. F. Chard (Dagenham) stated that the Institute of Ophthalmology wanted assistance from industrial medical officers concerning type and frequency of eye complaints met with in factories. The Institute was willing to supply special cards for this purpose. Dr. J. C. Bridge (London) asked what was the purpose of such records. Dr. L. B. Bourne (London) explained that the object was to set up a standard of treatment of industrial eye injuries and that until basic information was available this could not be done.

The Industrial Medical Officer and Accident Prevention

Dr. J. A. A. Mekelburg said that the number of reportable accidents during the year 1944 was 283,581, and of these 1003 were fatal. Assuming an 8-hour day, the number of man-hours lost by these accidents becoming reportable is in the region of 6¼ million hours, to say nothing of the hours lost after the accidents became reportable. To put it another way—the lost time of these accidents is equivalent to closing down completely for a year a factory of 3000 working a forty-hour week. Such a closure would obviously be a major disaster. Each reportable accident is a major disaster to the individual concerned.

An accident can be defined as 'an unlooked-for mishap or an untoward event which is not expected or designed by the sufferer.' Such an event has a three-fold result. Firstly, in a physical or mental injury to the worker, the nature of the injury varies from minor degrees of shock to severe disablement or even death. Secondly, if the accident is such that it becomes reportable, the worker suffers financial loss with consequent domestic embarrassment. Although there have been substantial increases in compensation rates in the past few years, the amount paid is insufficient to permit the worker to meet his normal weekly expenditure. Thirdly, an accident occurring in the works inevitably results in disorganization in the department in which it occurs and interference with and loss of production. Drawing an analogy between accident and disease, an industrial disease may be defined in similar terms, for the disease is an accident to health arising 'out of and in the course of employment.'

As medical officers in industry we are intimately concerned with the health of the workers under our care, and every effort is made to combat the special health hazards peculiar to different industries. Possible health hazards are anticipated and precautions taken to avoid disease. An excellent example of this in the war just concluded was the elaborate precautionary methods undertaken, with very considerable success, to prevent TNT poisoning in the filling factories—the prevention of accidental disease. The industrial medical officer is therefore already 'preventive-minded' in his field of medicine. Why should he not turn his activities to the prevention of the ordinary everyday accidents which occur in every works? Although immediate steps are taken to repair injury by all available means, surgery, physio-therapy, rehabilitation, etc., and to get the injured worker back to his pre-accident job, a worker who has lost a hand, for example, will not be able to return to his job on a power press or guillotine. How much greater satisfaction would it have given if by careful anticipation the machine had been so guarded that an accident could not have happened. Part II of the Factories Act, 1937, deals exclusively with Safety. It is laid down that every prime mover, every part of transmission machinery and all other machinery 'shall be securely fenced.' Section 17 of the Act, in dealing with the construction and sale of new machinery, states that certain parts of such machinery shall be effectively guarded. There have been lengthy discussions on this section; often when a new machine is installed it is found that there are other parts which must be guarded, and it is argued that these parts should have been guarded in the course of the manufacture of the machine. This is not always the case, so every machine must be given a thorough vetting before it is put into production.

It may be said that the job of guarding machines is the job of an engineer who knows all about machines, and it is his job to see that the machines do the work for which they were designed; but what is unfortunately often forgotten is that the machine is worked by a human being. That human being is only human and has his faults, and he must be prevented from injuring himself. On this question of the guarding of machinery, co-operation between the engineer and the medical officer, in fact co-operation all round, will result in the prevention of many accidents. It has been said many times that one of the duties of the medical officer is to know his factory; and to know the different processes carried out it is necessary to get about the works—it cannot be done from the consulting room. In the course of daily tours of the works the doctor will observe the working of machines. He has been trained to observe, and as the result of his observations he will

be able to visualize possible accident hazards. These could then be guarded against and accidents prevented. It is unnecessary to have special technical knowledge of machines, for when a danger point has been discovered and reported, it then becomes the duty of the engineer, the carpenter, the sheet-metal worker or the wire worker to devise something which will prevent an accident at that point.

So far, accidents have been spoken of as if they were caused solely by machinery. But this is not the case, for the Chief Inspector of Factories shows, in his annual report for 1944, that only 15·6 per cent. of all reportable accidents were caused by power-driven machinery. The remaining 84·4 per cent. resulted from non-machinery causes such as the handling of goods, persons falling, struck by falling body, the use of hand tools and stepping on and striking against objects. If a careful record is kept in the medical department of the types of accidents and the departments in which they occur, much useful information is obtained and steps can be taken to prevent recurrences. By indicating an accident on the medical record in, say, red ink, accident proneness may be spotted. Then by investigating the case it may be possible to prevent a serious accident by recommending a transfer to another department.

The value of such records may be illustrated by two examples. During the war women were employed in the biscuit industry on what is known as ' back of oven ' work. This job entails taking hot wires or pans with the baked biscuits from the oven and placing them on a rack to cool before packing. A very large number of small burns on the wrist and lower forearm were recorded. On investigation it was found that the pan-holder in use did not give full protection to the wrist and forearm. Another type of pan-holder was introduced and burns are now practically non-existent. A second example is also of interest. Biscuits for the Services were packed in cannisters. These cannisters had a circular opening with a sharp edge upwards. Girls doing the packing got innumerable cuts on the knuckles and wrists when placing the packets in the cannisters. A tin guard was made to cover the opening and cuts were prevented. At first some of the operatives avoided the use of the guard when they got a chance, but later, when they found that their colleagues were not getting cuts and worked free of the fear of cuts, they all used them. It might be said, ' Why go to all this trouble when a pair of gloves would have prevented the cuts? ' It is a fundamental point in accident prevention that the fitting of an appliance to, or the provision of some form of protective clothing for the worker, is an admission of failure to deal with the subject in some other way. At present it is necessary for the worker to use certain protective appliances, for example, goggles or face mask for the prevention of arc eye in the welder; but who is to say that at some time in the future some provision will not be made so that the welder can do his job without these aids?

Hernia is a frequent occurrence. Much could be done in the prevention of this condition by the proper selection of workers for jobs and instruction in the correct way of lifting, or in the provision of some mechanical means to do the lifting when it is really heavy. Where lifting has to be done by two or more workers the importance of proper sizing as to height and arm length must not be overlooked. It may be said that it is not the function of the medical officer to interfere with the set-up of a department, but I would submit that if it is observed that something is being done which may cause physical injury to a worker, attention should be drawn to it and steps taken to prevent such physical injury. Injury to the muscles of the back is often caused by improper lifting and ' Safety Pamphlet No. 16,' issued by H.M. Stationery Office, is a useful book on the subject.

The juvenile or young person entering industry for the first time frequently has an accident in his early days at work. Some injuries may be so serious that he is maimed for life—right at the onset of his career. The pre-employment examination has taken some time to determine whether he is physically fit for the job offered him. Why not spend a little more time in telling him of the non-mechanical hazards in the department for which he is destined? Such talks by the medical officer may be the means of preventing many accidents and might even be given to adults.

Lighting, heating and ventilation are subjects with which we are intimately concerned from the point of view of the health of the operatives. But defective lighting, heating and ventilation are often contributory causes of accidents and this again shows the close relationship between the work of the medical officer and the accident prevention officer.

During the past few years much has been said and written about the rehabilitation of the injured worker. In this work the industrial medical officer has been actively interested from the point of view of the resettlement of the worker, but by the active prevention of accidents the necessity for rehabilitation after an accident will in time be unnecessary. Under the Disabled Persons (Employment) Act, 1944, industry will in due course be called upon to employ a fixed quota of disabled persons. Special attention will have to be paid to this type of worker to make sure that he is suitably instructed in the hazards, if any, of the job. The usual organization in a big works for the prevention of accidents is an accident prevention officer and a committee consisting of representatives from management and workers. With his interest in prevention the medical officer should also be part of the organization. In such factories the accident prevention organization is usually very active, but in the smaller firms where there is no specially appointed official little is done beyond the minimum requirements of the Factories Act. It is in these smaller firms that a medical officer can help much in the prevention of accidents.

Strikes

Dr. T. A. Lloyd Davies briefly traced the changes in industrial organization which have taken place since the industrial revolution. Though the journeyman and master craftsman sought a hard living they worked as individuals responsible to each other. The journeyman always hoped to, and frequently did, become a master craftsman. Though the industrial revolution was accompanied by a catalogue of physical changes, the greatest evil resulting from the mechanization of industry was the gulf between employer and employed. The two sides of industry regard each other with suspicion. A strike is the organized withdrawal of labour, and the final stage in support of employees' demands; but unless all other methods of settlement have been exhausted and unless supported by some means of public sympathy and a strong organization with financial backing, it is unlikely to be successful.

Strikes might be of several types: (1) Political, for example, the general strike of 1926. (2) Economic, i.e. in support of wage demands. (3) For the betterment of conditions of work. (4) Sympathetic—the surprising thing about the dockers' strike in the autumn of 1945 was not that it took place but the speed with which it spread. (5) Collective fatigue or emotion—for example, miners are always held in suspicion by the community, they are subject to exhortation to produce more coal in unsatisfactory working conditions, but have never been the subject of real attempts to improve working conditions, food or shift arrangements.

The characteristic of the road transport industry was the frequency with which grievances—which in any other industry would be easily adjusted—led to lightning and widespread strikes. Bartlett (*Proc. roy. Soc. Series B.*, **131**, 247, 1943) has shown that fatigue after highly skilled work results *inter alia* in extreme mental irritation. Such was the result of work as a bus driver and conductor; this suggestion was supported by the loss of men from the industry after the age of 45 years. Dr. Lloyd Davies showed graphs of the age distribution and

of the difference between the observed population and the expected population (if the age distribution of all males had been followed) which in all cases showed a serious loss of men from the road passenger transport industry (with the exception of tram drivers) after middle age.

The strong group spirit, antagonistic of authority, shown by merchant seamen, is an example of collective emotion.

In the future, strikes—having their origin in emotional or fatigue phenomena—would be symptomatic of collective illness and become less and less an economic weapon. Until the gulf between employer and employed was bridged, strikes, as symptomatic of an illness of the community, would become increasingly more frequent.

Some observations on analysis of certified sickness absence

Dr. J. Tarsh referred, in the first place, to what he termed the background of sickness absence recording in industry. This includes relevant factors, such as methods of collecting data, the uniformity of its application, allowances for locality, type of work, hours of work, shift work, night work, old established or newly established factory, private enterprise or state-controlled industry, and the like. Some of the pit-falls that he came up against in the recording of sickness absence were only dealt with by a process of trial and error and the path of bitter frustration. (1) If the recording of sickness absence and its subsequent analysis is intended to supply a sound knowledge of industrial medical practice, it will assuredly fail in that purpose, for an hour's walk round the factory will teach you far more about industrial conditions than a week's study of graphs, statistics and such like. (2) The process of obtaining sound data involves routines which can be time and soul destroying. (3) The tangle of detail inclines one to inferences that are based on the 'post hoc ergo propter hoc' line of argument. (4) The sympathetic approach to the problems of sickness absence from work so very necessary for a sound understanding of the difficulties of modern industrial conditions, is replaced by a carping and critical inquiry, forgetful of the old legal maxim 'de minimis ne curat lex.'

Few doctors would exclude the taking of a case history from their process of arriving at a diagnosis; so recording, that has for its primary aim the taking of case histories (both for the individual and en masse) must justifiably be part of the industrial medical officer's duties. Pre-employment examinations plus routine follow-ups; control of the first-aid rooms; examinations of cases referred from the welfare and labour departments; and examinations of employees who have sought the doctor off their own 'bat' all yield case-history data. But, and this applies with great force in a factory of many thousands of employees, much ill-health only comes to light from an inquiry into sickness absence records. Repeated absence for headache may indicate eye-strain; debility and anaemia when repeatedly advanced as the excuses for absence may indicate a problem for the welfare department, or conceivably, the need for an individual ventilating exhaust system for those using a dangerous substance such as carbon tetrachloride. Again, frequent colds, bronchial catarrh, especially amongst a group of stable and conscientious employees, may indicate a 'wind-swept' shop. The study of day-to-day findings well repays the effort involved. In the course of time, when the data and inferences from many industrial medical officers are collated at a central statistical department by those trained in analysis, surely much good will result.

Absenteeism, like rehabilitation, is still front-page news. Absenteeism from the coal mines is the whipping boy of the politicians. Absenteeism as presented by the Ministry of Mines is divided into voluntary and involuntary, the latter being explained by no more than absence for which a reasonable excuse is advanced. One can only guess at the real amount of sickness in the industry. Detailed analysis is obviously required. Again, the Ministry of Labour have advised a different method for the recording of analysis of absence from work. Fortunately the Industrial Health Research Board has advised a good workable system flexible enough for application to most industries, and in the past few months has published three instructive pamphlets on various aspects of sickness absence from work.

The data presented in this paper have been obtained in a manner similar to that advised by the Board and cover some 10,000 employees for the years 1943/1944. Remarks in this paper are confined to certified sickness absence only and such absence means absence of three days or more, certified by an outside doctor. Absences for less than that period, even though certified, have been excluded as they are infrequent and have little bearing on the subject as a whole.

General Observations. Certified sickness absence is subject to seasonal variation. It exhibits its annual peak in January to early February, and markedly decreases as spring approaches. Throughout the remainder of the year it remains more or less steady, with a slight reduction before the midsummer and Christmas holiday periods.

Over the past four years, certified sickness absence amongst staff employees has always been less than uncertified sickness absence, the converse obtaining for hourly-paid employees. This may be attributable to the extra hour of work done by the latter class of employees; on the other hand, it may be that the former, having less arduous work, better working conditions or a greater loyalty induced by security of tenure, have less cause to be ill, or return to work in a shorter time. It is believed that the hourly-paid employees suffer from the cumulative effect of the extra hour of work.

Another feature well illustrated graphically is the relationship between certified and uncertified sickness absence. In pre-war days, the graph of these two classes of absence repeatedly criss-crossed each other, but during the war years there was a large gap between them. In 1943, these absences resumed the graphical characteristics exhibited in 1939, but the influenza epidemic of that year which originated in November separated them, and during 1944 and 1945 the gap has been consistently present, but with much less divergence. It cannot be explained why 1943 was exceptional; it was thought that the medical department was showing the fruits of its labour, but since then there has been disillusionment. It is believed that when conditions become normal again this graphical criss-cross will be seen once more, and any departure from it may portend ill-health or adverse labour conditions.

Specific Data. Data have been subdivided so as to allow comparisons between: (1) Males and females. (2) Married and single. (3) Five age groups which are: Under 18, 18–20, 21–25, 26–40 and over 40. (4) Staff and works. (5) Machine and assembly shops.

TABLE 1

DAYS LOST PER OPERATOR PER YEAR DUE TO CERTIFIED SICKNESS (1943/1944)

	Total	Works	Staff
Subdivision I			
Men	6·0	7·3	
Women	10·25	8·0	
Subdivision II			
Men (single)	5·5	7·0	
„ (married)	6·75	7·4	
Women (single)	10·8	7·7	
„ (married)	9·2	6·3	

All absences recorded are covered by medical or hospital certificates.

TABLE 2

PERCENTAGE OF TIME LOST ON ACCOUNT OF CERTIFIED SICKNESS DUE TO THE MAIN CATEGORIES OF CERTIFICATION

	Women (hourly paid) per cent.	Men (hourly paid) per cent.
1. Colds and influenza ..	17·7	16·3
2. Respiratory conditions	15·5	14·2
3. Digestive	8·5	9·9
4. Nervous system ..	11·8	6·2
5. Accidents	1·56	2·9
6. Rheumatism ..	5·7	6·8
7. Miscellaneous ..	21·00	31·00

It may be noticed that colds, influenza and respiratory conditions constitute one-third of all absences but in a lesser degree in males. With regard to accidents, males lost twice as much time as females, as would be expected, and only slightly more for rheumatic diseases. The miscellaneous category covers a great deal of absence and needs further subdivision. This is a job for the Industrial Health Research Board.

Industrial fatigue is a definite entity but difficult to diagnose. General practitioners frequently dislike putting 'fatigue' on a N.H.I. certificate, and put as an alternative 'anaemia' or 'nervous debility'; these two groups have therefore been analysed (Table 3).

TABLE 3

DAYS LOST PER PERSON PER YEAR THROUGH CONDITIONS PRESUMED TO INDICATE FATIGUE

	Females (days)	Males (days)
Anaemia	0·3	0·02
Nervous debility	1·25	0·24

It will be noticed that the females are absent fifteen and six times more than males.

The classification of days lost by the various age groups is illustrated in Table 4.

TABLE 4

DAYS LOST BY AGE GROUPS—ALL CAUSES

	Under 18	18–20	21–25	26–40	Over 40
Works					
Single women	5·75	9·0	10·5	11·5	17·7
,, men ..	1·9	3·0	6·5	3·2	9·5
Married women	—	7·7	13·7	8·75	10·25
,, men ..	—	—	—	4·9	7·25
Staff					
Single women	2·9	9·2	9·0	7·3	4·9
,, men ..	2·3	2·7	5·4	8·6	11·3
Married women	—	—	8·9	5·9	5·75
,, men ..	—	—	—	6·4	7·6

Analysis of Figures. Analysis of age groups when related to the various certified sickness categories provides a great mass of data and therefore no more than a few general observations can be given here. These are presented with much trepidation for they are of little value unless other industrial medical officers publish their findings and so provide comparative data. (1) Persons of both sexes under 18 years of age lose only half to one-third as much time as all other age groups. Taking the other extreme of age, i.e. those over 40, it would appear that (*a*) men, both single and married, lose twice as much time as males under 40; (*b*) married women over 40 lose no more time than married women under 40; (*c*) single women over 40 lose nearly twice as much time as single women under 40; the converse obtains with staff employees. (2) The time lost from almost all diseases is greater in the higher age groups. (3) Diseases of youth are colds and respiratory diseases. Diseases of age are digestive, rheumatism, female diseases, and (with men only) accidents. (4) Colds and influenza cause the greatest amount of lost time in general, attacking especially the older women. In the healthiest categories, i.e. single men and women under 18, they are some five to ten times more severe in machine shops than in assembly; in other categories this is not so marked. Women lose three times as much time due to these two conditions as men in machine shops, and twenty times as much as men in assembly. (5) Respiratory conditions cause almost as much lost time as colds, with women losing five times more time than men. (6) Digestive conditions are responsible for a major proportion of lost time, negligible in lower age groups and severe in the highest. Women lose only 10 per cent. more than men. (7) Nervous conditions, other than nervous debility, e.g. neurasthenia, are a negligible cause of absence, but most severe in older women. (8) Accidents cause only a small amount of lost time, men over 40 losing ten times as much time as other men, and twice as much as older single women. Women lose only half as much time as men. (9) Rheumatism is an important cause of lost time, negligible in the young but severe in the older age groups, with single or married men about equal. It is twice or three times as severe in machine shops.

Finally, here are one or two deductions: Health is markedly better under 18 and markedly worse over 40. There may be a tendency for health to deteriorate on marriage and often to improve as the years go by. Women who remain unmarried over 40 suffer a severe deterioration in health.

BIRMINGHAM GROUP

A meeting of the Group was held at the Birmingham Accident Hospital on November 23, 1945, Dr. W. J. Lloyd in the chair. The subject for discussion was 'Airborne respiratory infection in industry,' opened by Dr. O. M. Lidwell, Medical Research Council, National Institute for Medical Research, Hampstead, N.W.3, and Dr. A. Brian Taylor, Physician to the Birmingham United Hospital.

Control of Respiratory Infection

In this discussion Dr. Lidwell was concerned only with the possibility of reducing the concentration of infective material suspended in the air. Such material will be drawn in with the inspired air and a high proportion retained in the respiratory tract. There is very little information as to the magnitude of an infecting dose under these conditions and the reduction necessary to produce an appreciable decline in the incidence of clinical infections is also uncertain. In addition, the relative importance of various localities, e.g. workroom, office, canteen, transport, cinema, etc., in determining the number of respiratory infections is not obvious and success in limiting cross-infection in any one might have only a small effect on the total number of infections occurring. These uncertainties serve to emphasize that the subject is in an experimental stage and that the results of controlled field studies are likely to be of considerable general interest.

Consider the air in any room; infective material may be introduced in a variety of ways. Ventilation with outdoor air will introduce a very small amount. Air recirculated through a plenum system may be more or less heavily contaminated according to the source from which the air has been drawn and the efficiency of the filtration system. Interchange of air with other rooms in the building by thermal convection or other sources of air displacement may be greater than is suspected. The inhabitants of the room will disperse their salivary flora by talking or coughing and, possibly, in very large numbers by sneezing. In addition, any activity may redisperse infective material from secondary reservoirs

in which it has accumulated, e.g. dust on floors, shelves, etc., clothes and other textiles.

Simultaneously the infective material is being removed from the air of the room in three principal ways. Firstly, the suspended particles are continually sedimenting on to the floor and other surfaces, where, in the absence of any special measures, they contribute to the secondary reservoirs and may be redispersed. Secondly, there is a continual removal by ventilation and air interchange. Thirdly, the bacteria and virus particles concerned may be dying at an appreciable rate either naturally or as a consequence of specific bactericidal or viricidal agents.

The aerial contamination at any time depends on the balance struck between the rate of dispersion of infective material and the rate at which it is being removed. With steady conditions the relationship is a simple one and

$$N \simeq \frac{\text{Rate of dispersion}}{\text{'Sedimentation Rate'} + \text{'Ventilation Rate'} + \text{'Death Rate'}}$$

where N is the number of infective particles in a given volume, usually a cubic foot, of air. Removal of infective particles from the air by sedimentation, ventilation or death, is normally an exponential process and these rates refer to the then constant rate of fractional reduction of N, i.e. in mathematical terms, $\frac{1}{N} \cdot \frac{dN}{dt}$. For ventilation this is equal to the number of air changes per unit time, and the sedimentation and death rates can be regarded as equivalent in effect to a numerically equal rate of ventilation.

Some numerical estimates may be of interest at this point. Bacteria-carrying particles, as ordinarily found, (there is practically no data referring to viruses) settle in still air at rates varying from 10–200 feet per hour (these settling rates would be attained by spheres of unit density of 5–25μ diameter). These figures correspond to a sedimentation rate, in rooms of ordinary height, 10–15 feet, of 1–20 per hour and an average value would be about 5. Mechanical ventilation is commonly of the same order of magnitude, 3–6 air changes per hour. The natural death rate, while important in limiting build-up in the secondary reservoirs, is usually small compared with these figures. The rate of dispersion may be very varied. Most measurements of N refer to total bacteria-carrying particles irrespective of classification into pathogenic or non-pathogenic forms and it seems reasonable to use such figures for comparative purposes as indicative of the risk of exposure to pathogens should these appear. In ordinary circumstances the numbers of pathogens present are too small for reliable estimation, and attempts to use specific organisms, e.g. salivary streptococci, as indicators of human contamination, much as *B. coli* in water, have not been altogether successful.

Under normal fairly good conditions the numbers of bacteria-carrying particles, of all types, per cubic foot of air may average round 20–40. In urban outdoor air the figures are about one-tenth of these. Since an average man breathes about 20–30 cubic feet of air per hour it is clear that the total inhaled bacteria is often considerable and that a high proportion of pathogenic forms might constitute a serious risk.

Reduction in the amount of infective material in the air, i.e. reduction in N above, can be achieved by—

(*a*) Reducing the rate of dispersion. This can be achieved by attention to good manners, elimination as far as possible of carriers, general cleanliness, use of oil on floors to lay dust. The wearing of masks, while probably a very effective measure, is likely to be impracticable except in special circumstances. Mention may also be made here of the possibility of reducing cross-infection due to direct projection by attention to the relative positions of workers and the interposition of screens in particular places. The proportion of cross-infection by this route is again unknown but is not likely to be much affected by ventilation or germicidal agents.

(*b*) Increasing the rate of removal. The sedimentation rate is not, in general, susceptible of alteration. Ventilation is the most certain method and, if properly carried out, the least likely to be associated with undesirable features. In the past ventilation requirements have been assessed on the basis of removal of odours, but it is clear from this discussion that removal of infective material may suggest a considerably higher standard than the six air changes per hour often accepted as good ventilation. Experiments at considerably higher rates of ventilation have given very promising results. The principal obstacles to large-scale use are the engineering costs and the amount of heating needed in cold weather.

The use of ultra-violet irradiation or chemical vapours to increase the bacterial death rate will occupy the rest of this paper.

The Use of Ultra-violet Irradiation. It is easy at moderate irradiation intensities to obtain rapid death rates of freshly sprayed organisms, either from the mouth or from culture, at moderate relative humidities. The organisms found in dry dust are very much more resistant. Increased relative humidity reduces the effectiveness. The death rate is proportional to the intensity, and an intensity of 10 milliwatts per square foot at 2537 A° will lead to a death rate of nearly 100 per hour with sprayed saliva at 50 per cent. relative humidity. The low-pressure type mercury discharge lamp is the most suitable, the radiation being nearly pure 2537° A. Such lamps are manufactured in the U.S.A. by Westinghouse and the General Electric Co. The 15-watt types have an output of 2–5 watts at 2537° A. Similar lamps have been supplied by the British Thomson Houston Co., and a somewhat different model by Hanovia Ltd.

The practical difficulties in the use of ultra-violet irradiation for air sterilization in occupied rooms arise from the fact that, except in situations where personnel will wear goggles, the lamps must be so screened as to be invisible to the occupants of the room. In effect this means that only the air above the 6–7 foot level can be irradiated. Reduction in the infective material inspired by the occupants is then dependent on the vertical circulation of air in the room and if the radiation intensity above 6–7 feet is adequate the effective death rate over the room as a whole will be entirely determined by the vertical circulation. In ordinary rooms the maximum value of the death rate determined in this way may be between 12 and 60 per hour. It may be increased by the judicious placing of heaters and the use of fans to provide vertical circulation but it is difficult much to exceed these figures. An adequate radiation intensity in the upper part of the room, say a mean value of 20 milliwatts per square foot, will usually need about one 15-watt lamp per 1000 cubic feet of total room space. This will not be very effective against dry dust-borne organisms.

Chemical Bactericides. If it is to be suitable for use as an aerial bactericide, a substance besides being effective must be non-toxic, tolerable, economical and simple in use. A large number of substances have been proposed but no one of them ideally fulfils these conditions.

A large number of completely ineffective mixtures are advertised. Many consist essentially of pine oils with some formaldehyde and a little dye, but there are many other ' sweet-smelling ' nostrums.

A few words may be said about the more potentially useful substances. In all cases the effectiveness is very dependent on relative humidity and the nature of the bacteria-carrying particle. Dry dust-borne bacteria are the most resistant, saliva freshly sprayed from the mouth is moderately sensitive, sprayed cultures are usually very sensitive. Little killing effect is obtainable below 30 per cent. relative humidity, a maximum effect is obtained between 60–80 per cent. relative humidity and a less effect again at higher humidities.

Hypochlorous acid, usually obtained by spraying solutions of sodium hypochlorite, may be used at a concentration of about 0·02 g. per 1000 cubic feet of air. It is harmless but has an appreciable smell and may corrode metals. Reaction with organic matter leads to loss in the air, but the deodorizing action may be useful.

Resorcinol is effective at a concentration of 0·03 g. per 1000 cubic feet and is easily vaporized by heating. Maintaining this concentration is difficult owing to its rapid disappearance, probably by oxidation in the air. This substance has been promoted commercially. Propylene glycol and triethylene glycol have been used by American workers. Considerable quantities of propylene glucol are needed, 1–2 g. per 1000 cubic feet, and its bactericidal effect is not very great. Triethylene glycol has a limited useful humidity range, which considerably restricts its potentialities in this country and we have no personal experience of it. Both these glycols are easy to vaporize by heating and to maintain at the desired concentration.

We have recently explored the α-hydroxy acids of the aliphatic series. All of those tried have an appreciable bactericidal action in the air. Lactic acid is probably the most effective of all the bactericidal agents so far examined against dry dust-borne organisms. At a concentration of 0·1 g. per 1000 cubic feet it is unobjectionable but becomes irritant not far above this level. Owing to decomposition when heated it must be steam distilled into the air. Among the other members of this series mention may be made of α-methyl, α-hydroxy butyric acid. This may be vaporized very greatly without decomposition from a surface at 100–120° C., and irritation is not noticed at concentrations less than two to three times the working concentration of 0·08 g. per 1000 cubic feet. Lactic acid is readily obtainable and quite harmless at the above concentration; only preliminary work has yet been carried out with the other hydroxy acids.

In conclusion there is one point concerning the relative ineffectiveness of both ultra-violet irradiation and chemical agents against dry dust-borne organisms. Total organisms, which in most environments are largely of this type, have been suggested as a reasonable index of the bacteriological cleanliness of the air. It does not follow that they are a reliable index of the effectiveness of various agents in reducing the risks of cross-infection. Certain infections may be primarily transmitted by material freshly sprayed from nose or mouth. Others, particularly possibly the streptococcal infections, may also be acquired from infected dust. As at so many other important points there is a fundamental lack of knowledge here.

Airborne Respiratory Infection in Industry

In discussing the problem from the point of view of the physician Dr. Brian Taylor maintained that acute respiratory diseases are the chief cause of lost time due to illness among industrial workers, and statistics confirm this. The Ministry of Health in 1933 recorded the results obtained in a representative sample of over a million insured persons, and the figures show that well over a third of the cases were accounted for by respiratory diseases—influenza, bronchitis, tonsillitis, colds, pneumonia, etc., excluding pulmonary tuberculosis. Influenza probably includes a variety of respiratory conditions and is not a very exact diagnosis, but may well be included in this group. As a cause of mortality, respiratory disease is less obviously important, though from the point of view of the working man it may well be as significant as in the incidence of morbidity. In statistics of the principal causes of death, heart disease and cancer stand higher than diseases of the respiratory system, but it must be remembered that these are diseases of later life and therefore less likely to interfere with the average working life of the industrial population. Diseases of the respiratory system, excluding tuberculosis and influenza, represent about 13 per cent. of the causes of death and are considerably higher than any of the others. Tuberculosis comes between 5 and 6 per cent. and is therefore an important additional factor, especially as it is a disease of the prime of life. The problem is therefore obviously an important one, and its control would be of great assistance to the health of the population generally, as well as to industry in particular.

In considering these conditions of ill-health, infection is the most potent factor in their aetiology, and airborne infection is by far the commonest mode in which it occurs. One therefore has to take into consideration the question of the infection itself, its nature and dosage, and also the resistance and defence mechanisms of the body. Droplet infection by coughing and sneezing is probably the chief way in which the organisms are spread from case to case; and the dosage must be remembered as well as the virulence of the organisms. In epidemics with highly virulent infections rapid spread is notable. In more isolated cases, the lack of hygienic habits of the average person in protecting the nose and mouth when coughing or sneezing is an important factor.

The training of people in industry along these lines should provide considerable improvement in the incidence of infection, but owing to the natural weakness of the human individual it is fraught with much difficulty. The segregation of individuals in the early stages of respiratory infections is an optimum recommendation, but the usual desire to work—or at least to avoid sickness—makes many people continue to attend their work when they would be better away, from their own point of view as well as from that of their neighbour. The wearing of masks is also a good thing, but usually impracticable, as is seen in the difficulty of making miners wear masks to protect themselves from the dust diseases. The possibility of sterilizing the atmosphere has been studied extensively, and may prove a solution to much of this difficulty, especially as it may be possible to do it without the workers knowing, or at least without interfering with their personal comfort.

Another important factor to be considered is the resistance of the individual; and this is under the control of numerous influences. It is well known that fatigue and malnutrition, too, allow the invasion of organisms much more readily. Over-long working hours, trying conditions of work as well as of life—as have prevailed during the last few years—must have had a very considerable effect on increasing the incidence of minor maladies, which has been noted among workers in industrial medicine. Minor degrees of avitaminosis have frequently been given as a possible cause of increasing susceptibility to infection, though perhaps the enthusiasm of manufacturers of proprietary brands of vitamin preparations has been partly responsible. Few, if any, reliable statistics have been published to show that the addition of vitamins artificially has notably influenced the sickness rate. It is improbable that there is any real general deficiency in vitamin intake, though perhaps the optimum levels laid down by the League of Nations Commissions are not always reached; war-time diets have, on the whole, supplied a fairly adequate amount of vitamins. It has also been suggested that the lowered fat content of the diet, compared with peace-time, facilitates infection; but here again it is difficult to obtain any convincing evidence.

There is no doubt that atmospheric conditions do play a considerable part in the aetiology of airborne infections. In relation to the season of year, the winter is well known as the most dangerous period, and the fall of temperature at this time is always coincident with an increase of cases. Excessive cold is even more noticeably important. The other outstanding factors are the humidity of the air, changes of temperature, and the effects of draughts and cooling on the skin. An increase in the moisture of the atmosphere allows droplet infection to hang around more easily. Changes of temperature and draughts act by sudden chilling of the mucous membranes and skin surface and influence the peripheral capillary circulation adversely. It is the sudden changes that are particularly important, and therefore a high working temperature predisposes to sudden cooling, as in miners, furnace workers, etc., among whom respiratory infections are probably more common. Adequate ventilation is necessary to disperse fumes and droplet infection, and to maintain an even temperature, but with a movement of air of more than 40 feet per minute,

draughts are felt unless the air blast is directed away from the workers. Ventilation by air blast should not be more than 200 feet per minute, and the air should not be more than 5 degrees below the skin temperature. The movement of air is, of course, an important factor in allowing the natural evaporation of sweat from the surface of the skin, and a comfortable mean is desirable for this to be beneficial. In winter, the problem of controlling these important points in workshops—where excessive heat or excessive exposure to the outside elements make it difficult—increases the task that faces the industrial medical officer, who has to maintain the efficiency of his workers without interfering with industrial production and management.

A number of methods have been used to try to raise the immunity of workers to respiratory infections, but none has been very successful. The use of stock anti-cold inoculations has been variously reported on by different observers, but their uncertain effect is the most evident conclusion. Ultra-violet irradiation of the skin regularly and frequently has been tried, but here again no real success has occurred, and probably does not compensate for the trouble, expense and time required. Much attention has been devoted recently to the production of an anti-influenzal vaccine, as the causal viruses are becoming known. The difficulty at the moment is that more than one type occurs in different epidemics, and until the epidemic starts it is uncertain which is operating. However, recent work has suggested that an effective vaccine may possibly be produced in the not distant future. The production of some bactericidal or bacteriostatic agent of the type of penicillin, which is effective against catarrhal and other respiratory infections, may have a future which will be of great value. At the moment the prophylactic use of penicillin is still uncertain, and its oral administration has not been successfully achieved owing to destruction in the stomach, but the expectation of overcoming this is in view. One must also remember in this connexion that many organisms of the catarrhal group are insensitive, and others may become so by immoderate use of penicillin.

In conclusion, therefore, it would seem that the problem is made worse by the variety of aetiological factors. Control of infection in the air itself to prevent the passage from person to person is perhaps the most hopeful prospect for the future. The training of personnel in hygienic measures is difficult, though theoretically effective. Adequate control of working and of atmospheric conditions and prevention of overcrowding must be borne in mind, and will assist in diminishing the spread of infection. Inoculations and individual bacterial control are still in the experimental stage and at present not particularly helpful.

SCOTTISH GROUP

The annual general meeting of the Group was held on October 17, 1945, at the Institute of Hygiene, Glasgow University, Dr. H. M. Roberts in the chair. The following office-bearers for 1945–46 were elected:

Chairman: Dr. D. M. Watson.

Honorary Secretary: Dr. George Buchanan.

Honorary Treasurer: Dr. Edward Collier.

Executive Committee: Drs. J. Fleming, J. W. Henderson, N. Meiland, H. M. Roberts, D. G. Robertson and Grace Smith, with the chairman, Honorary Secretary and Honorary Treasurer, *ex officio*.

Prof. T. Ferguson said that Dr. Roberts had filled the chair during his term of office with dignity and tact; and had executed his duties in a delightful manner pleasing to all. He wished to propose Dr. Watson as successor to Dr. Roberts and, on his election, welcomed him to the chair for the years 1946 and 1947.

A dinner was held at the Grosvenor Restaurant, Glasgow, on October 20, 1945, Dr. D. M. Watson in the chair. This was the first social event held by the Group; in the words of the Honorary Secretary, 'it is pleasant to record that the meeting was an outstanding success, and the chairman in his remarks hoped that it would become an annual event at which members and their friends could meet.'

On December 12, 1945, Members of the Group visited the miners' rehabilitation centre at Uddingston. An introductory address was given by Mr. Alexander Miller, F.R.C.S., in which he stressed the importance of using rehabilitation of the injured as a continuous process beginning with early and adequate primary treatment at an orthopaedic department or fracture clinic and continuing throughout the out-patient department of the hospital and finally, where required, to rehabilitation centres in country surroundings. The problem in Lanarkshire was of special importance as this large industrial county was at present completely dependent for its hospital service on Glasgow; the need for more out-patient supervision had therefore become an urgent necessity until a regional plan for hospital services was established.

Almost 10 years ago the mining industry, recognizing the need of a suitable follow-up service for the disabled miner, initiated a rehabilitation scheme for disabled miners which was the first of its kind in Britain. Its aim was to treat the post-hospital patient and return him when fit to gainful employment in his pre-accident or alternative occupation. The work of this clinic was brought to the attention of the Miners' Welfare Commission, and in 1945 they agreed to take over the service and to establish the present centre in Uddingston as a non-residential rehabilitation centre for the coal-fields of Lanarkshire, Dumbartonshire, Renfrewshire, West Lothian and South Stirlingshire. The centre must be viewed as a hardening centre and is not intended as an out-patient dispensary.

The social aspects of rehabilitation have always formed a major part of the work in the original rehabilitation scheme in Lanarkshire, and the Miners' Welfare Commission have agreed to the appointment of a medico-social worker to the centre to allow expansion of this service in the field of rehabilitation. By means of the social worker a close contact is made with the hospital, the mining industry and with the general industries in the county so that on the surgeon's recommendation steps are taken, after investigation if necessary, to reinstate the patient to his own or alternative occupation. By means of this close co-operation of surgeon and social service it has been possible to return almost 80 per cent. of the patients at the centre to the mining industry and to place a further 10 per cent. in alternative occupation. The present attempt by the Ministry of Labour to organize a scheme for rehabilitation and re-settlement of the disabled was too much of a revolutionary change; such a scheme could not give the measure of success anticipated until suitable personnel were trained to make it effective. He considered that at this stage it might have been better to allow schemes of different types to function in selected areas where previous experience was available and where expansion of the scheme might proceed gradually. When such schemes had made their report then it was time enough to advise on a unified standard plan for the nation as a whole.

Following this introductory address a demonstration was given of the routine work of the centre. Early treatment was carried out by orthopaedic sisters (nurse gymnasts), the patient being taken through a course of individual exercises and gradually transferred to small class groups for resistance exercises. Thereafter recreational games were introduced, either under the supervision of the orthopaedic sister or, in the more advanced class, under the physical training instructor. Competitive games, indoor and out-door, were demonstrated to show how the disabled might be encouraged to adapt physical disability to active functional use.